How Well Do People Recall Risk Factor Test Results? Accuracy and Bias Among Cholesterol Screening Participants

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The authors conducted a community-based cholesterol screening study to examine accuracy of recall for self-relevant health information in long-term autobiographical memory. Adult community residents (N = 496) were recruited to participate in a laboratory-based cholesterol screening and were also provided cholesterol counseling in accordance with national guidelines. Participants were subsequently interviewed 1, 3, or 6 months later to assess their memory for their test results. Participants recalled their exact cholesterol levels inaccurately (38.0% correct) but their cardiovascular risk category comparatively well (88.7% correct). Recall errors showed a systematic bias: Individuals who received the most undesirable test results were most likely to remember their cholesterol scores and cardiovascular risk categories as lower (i.e., healthier) than those actually received. Recall bias was unrelated to age, education, knowledge, self-rated health status, and self-reported efforts to reduce cholesterol. The findings provide evidence that recall of self-relevant health information is susceptible to self-enhancement bias.

Keywords: cholesterol, risk factor, validity, memory distortion, bias

Identifying health risk is a priority in public health and medicine. Thousands of otherwise healthy individuals are screened every year for a variety of risk factors to prevent and manage disease. The ability of health professionals to respond appropriately to individuals and populations who vary in their risk is in part dependent on the accuracy of the patients’ recall of self-relevant health information. For example, recall inaccuracy could corrupt a medical history obtained by a physician (Barsky, 2002), whereas inaccuracies at the population level could distort public health surveys that rely on self-reports to assess the prevalence of health risk factors such as hypertension or hypercholesterolemia (i.e., Centers for Disease Control and Prevention, 2003; U.S. Department of Health and Human Services, 2000). Because of the prevalence and utility of self-reported health risk assessments in both clinical and public health contexts, it is important to rigorously evaluate the validity of such reports.

Although autobiographical recall can be accurate (Symons & Johnson, 1997), recall can also be biased in a self-enhancing manner (Greenwald, 1980). Self-enhancement biases are well established for judgments (Fiske & Taylor, 1991; Kruglanski, 1996; Kunda, 1990; Pyszczynski & Greenberg, 1987; Taylor & Brown, 1988), but there have been fewer studies of self-enhancement biases in autobiographical memory, especially for objectively measured health events (e.g., Caplan, Mandelson, & Anderson, 2003; Duncan, Sydeman, Perri, Limacher, & Martin, 2001; Lipkus, McBride, Pollak, Lyna, & Bepler, 2004). Demonstrating biased or self-enhancing memory requires an objective “gold standard” assessment of prior behaviors, a standard often lacking in the psychology literature (e.g., Klein & Kunda, 1993; Sanitioso, Kunda, & Fong, 1990; see Crary, 1966, for an exception).

In contrast, applied research in epidemiology has provided a wealth of evidence concerning the overall accuracy of memory-based self-reports but has not directly addressed the possible role of self-enhancement biases (Croyle, Loftus, Klinger, & Smith, 1993; Dwyer, Krall, & Coleman, 1987; Martin, Leff, Calonge, Garrett, & Nelson, 2000; Matthews, Nattinger, & Anderson, 2005; Natarajan, Lipsitz, & Niertert, 2002; Vargas, Burt, Gillum, & Pamuk, 1997; Warnecke et al., 1997). Biased recall of health risk factors is especially important given the heavy reliance on self-report in public health planning and surveillance. For example, the Centers for Disease Control and Prevention assesses risk factor status (such as hypercholesterolemia and hypertension) via self-report to plan and evaluate public health efforts in the United States.
States (Centers for Disease Control and Prevention, 2003), and such reports are a benchmark for health priorities in Healthy People 2010 (U.S. Department of Health and Human Services, 2000). Thus, any recall biases in this context are likely to have significant practical implications. The present study explicitly evaluates self-enhancement biases in recall of health information in the context of cholesterol screening. In particular, we looked at individuals’ accuracy for recall of total serum cholesterol and cardiovascular disease risk category 1 to 6 months after receiving their cholesterol test results in a naturalistic health screening context.

**What Factors Contribute to Inaccurate Recall of Cardiovascular Risk?**

People are generally poor at recalling the presence of previously diagnosed risk factors such as high cholesterol and hypertension. The estimated percentage of at-risk individuals incorrectly classified for these cardiovascular markers ranges from 9% to 60% (for a review see Newell, Girgis, Sanson-Fisher, Savolainen, & Hons, 1999; see Vargas et al., 1997, for an exception for hypertension recall). Further, recall appears to be biased in that people more accurately recall the absence rather than the presence of a risk factor, especially for high cholesterol (Martin et al., 2000; Natarajan et al., 2002; Newell, Girgis, Sanson-Fisher, & Ireland, 2000). For example, only 59% of individuals with high cholesterol correctly reported this condition, whereas 84% of those with normal cholesterol correctly recalled their risk status (Martin et al., 2000).

Despite such apparently self-serving patterns, methodological features of such studies implicate factors other than bias to explain recall inaccuracy for cholesterol risk. In several putative validation studies, the gold standard risk factor assessments took place after participants were asked about their risk factor status (Bowlin et al., 1993; Bowlin, Morrill, Nafziger, Lewis, & Pearson, 1996; Natarajan et al., 2002). Thus, it is unclear whether inaccuracy was due to memory processes or to a discrepancy between earlier and later screenings, the latter of which can be exacerbated by temporal variation in cholesterol measurements (Jacobs & Barrett-Connor, 1982; Tornberg, Jakobsson, & Eklund, 1988).

Even when risk factor recall occurs after screening (i.e., when medical records are used to determine prior risk factor status; Martin et al., 2000; Newell et al., 2000; Robinson, Young, Roos, & Gelskey, 1997; St. Sauver et al., 2005), inaccurate recall may be a function of classification error rather than recall bias. Many of the validity studies operationally defined a hyperlipidemic case as total cholesterol >200 mg/dL (Bowlin et al., 1993; Martin et al., 2000; Newell et al., 2000 used >213) and then evaluated recall accuracy by asking respondents whether they had ever been told that they have high cholesterol. That lipid standard may not be shared by clinicians, and indeed, U.S. guidelines at the time of these studies defined high total cholesterol as >239 mg/dL, although values from 200 to 239 were considered borderline high (Expert Panel on Population Strategies for Blood Cholesterol Reduction, 1991). Thus, the values used to define high cholesterol in the research setting were discrepant from the standard clinical risk categories used for diagnosis and labeling, which are presumably more likely to be used by an individual when recalling his or her risk factor status.

A final element of putative recall error involves patient counseling. In any given year, only 34% of hyperlipidemic patients receive cholesterol reduction counseling by their physicians (Stafford, Blumenthal, & Pasternak, 1997), so it is plausible that inaccurate recall for cholesterol test results is due more to heterogeneity in clinical feedback than to memory failures. In summary, earlier reports of asymmetry in accuracy for self-reported cholesterol risk could be the result of a number of factors, including the absence of a formal diagnosis and/or a lack of counseling regarding the presence of risk, the assessment of recall validity without actually measuring memory for an earlier screening event, or the mismatch between the definition of high cholesterol for the research team and the care provider during the screening event.

As this review suggests, the variability in the presence, content, and complexity of cholesterol counseling in medical interactions makes it difficult to uncover the processes that underlie memory failures by relying on naturalistic observations of unstandardized primary care interactions (e.g., Newell et al., 1999). To address these issues, we studied memory within a highly standardized medical care interaction in which the interaction and the information provided focused on one issue, cholesterol level. This information was presented in accordance with National Cholesterol Education Program (NCEP) guidelines, and all risk levels (low, borderline high, and high) were preserved in the counseling interaction and could therefore be precisely differentiated in the recall context. To rule out alternative explanations for recall error in prior lipid screening studies, we structured the study so that the screening event of interest preceded the recall assessment, all three recommended risk factor categories were used for case definition, and recall accuracy was evaluated by means of risk criteria that precisely corresponded with information provided to participants in the screening context. Finally, the health information provided to participants was embedded within a standardized health education counseling protocol designed to ensure that at the time of encoding, participants understood the meaning and significance of their test results.

**Characterizing Accuracy, Error, and Bias in Memory for Risk Factor Status**

Our study systematically addressed several other questions. First, does the length of the recall interval affect accuracy? Older information should be recalled less accurately, and one might expect that older information would also be more susceptible to recall distortions. To evaluate this question, we randomly assigned screening participants to be interviewed 1, 3, or 6 months after receiving their cholesterol test results. Second, we addressed the kinds of errors people make when their memories are inaccurate. If recall is characterized by a self-enhancement bias, we would expect that recall errors would not be random but instead be more likely biased in the direction of lower risk. We therefore expected that cholesterol screening participants who inaccurately recalled their cholesterol test result would be more likely to err in the direction of a more favorable test result.

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1 Low density lipoprotein, rather than total cholesterol, is currently the primary therapeutic target for hyperlipidemia (National Cholesterol Education Program, 2002). The graded risk categories for total cholesterol (borderline-high and high risk) are maintained in these guidelines.
Third, we evaluated two possible theoretical explanations for a self-enhancing recall bias. To the extent that ego-defensive motives or self-enhancement biases in health-related judgments are operating (Croyle & Jemmott, 1991; Ditto & Lopez, 1992; Kunda, 1987; Liberman & Chaiken, 1992), one would expect a greater self-enhancement bias when the information to be recalled has more negative implications. More specifically, if a defensive process is at work, one would expect that biases would be more likely and/or more severe as self-relevant information becomes more unfavorable. Conversely, schema theory (Bartlett, 1932; Fiske & Taylor, 1991) predicts that if people generally view themselves as healthy, recall for unfavorable information may be distorted simply because it is inconsistent with the self-concept (Kruglanski, 1996). We included a measure of global self-rated health status to determine whether self-enhancing biases in memory might be more likely to occur among individuals with a healthy self-schema. We also assessed a wide range of demographic, health knowledge, and health behavior variables to address their role in recall accuracy.

Method

Participants

Salt Lake City area residents were recruited via newspaper advertisements, radio spots, and posters to participate in the University of Utah Cholesterol Screening Project (approved by the University Institutional Review Board). Persons who had received a cholesterol test result within the previous 6 months were ineligible. Once individuals scheduled a screening visit, they were told that they would be paid $8 for their participation. The data reported here are based on 496 adults (268 men and 228 women) who participated in both the cholesterol screening and the follow-up interview. Those not completing the recall portion of the study (10.5% of the original 554 screening participants) were younger ($M = 39$ years old, $SD = 1.9$ vs. $M = 44$ years old, $SD = 0.7$, $p < .01$) and more likely to have never married (40% vs. 18%, $p < .01$) than those completing follow-up but were otherwise similar for demographic, affective, and prior cholesterol testing variables ($ps > .13$).

Sample participants ranged from 18 to 81 years old. Most were Caucasian (92.3%), married (64.7%), and employed either full- (50.4%) or part-time (17.5%). About 1 in 5 had never attended college (20.8%); with others reporting some college (39.0%) or a college degree (40.2%). Most (63.0%) reported a prior cholesterol test.

Procedure

Cholesterol screening session. After signing a consent form, participants (in individual sessions) completed the baseline questionnaire, which included demographic, behavioral, and health history questions. Self-rated health was assessed on a 5-point scale from poor to excellent. The last section of this questionnaire consisted of the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988), which includes reliable and well-validated measures of positive and negative affect (Watson, 1988). Participants indicated the extent to which they felt each of 20 feelings “during the past few days.” The 10 subscale items were summed to create positive affect and negative affect measures ($a = .85$).

Participants then completed a 10-item cholesterol-related knowledge questionnaire. This measure had low internal consistency ($a = .56$), so analyses involving cholesterol knowledge should be interpreted cautiously. A nonfasting, total cholesterol test was then performed with a finger-stick blood draw. Samples were analyzed immediately by means of the Reflotron (Roche Diagnostics, Basel, Switzerland). This machine meets the NCEP performance recommendations for precision and accuracy (Sedor, Holleman, Heyden, & Schneider, 1988). Once the specimen is inserted, the Reflotron yields a total cholesterol test result in about 3 min. All testing personnel were required to demonstrate proficiency (proper collection technique and ability to obtain accurate specimen values with repeat measurements ±2%) and to conduct regular quality control assays.

After participants were told their total serum cholesterol level (in mg/dL) and risk category (desirable <200; borderline-high risk, 200–239; high risk >239), they received cholesterol education and follow-up information that complied with NCEP II guidelines (Expert Panel on Population Strategies for Blood Cholesterol Reduction, 1991). Counseling included a discussion of total cholesterol, a description of its role in heart disease, and recommendations concerning ways to lower cholesterol and dietary fat intake. The meaning and implications of the participant’s test results were described, but participants were not provided with a printed record of their results. Follow-up recommendations were based on the participant’s total serum cholesterol level and additional NCEP risk factors reported by the participant during the health history portion of the baseline questionnaire.

Follow-up interviews. Participants were randomly assigned at baseline to be interviewed 1, 3, or 6 months after the testing session. Care was taken to ensure that no participant was interviewed by the research assistant who conducted his or her screening test. Although all participants expected to receive a follow-up telephone call, they were told neither when the call would be made nor that recall would be assessed in the interview.

When contacted by telephone, respondents were instructed to “answer from memory, without consulting your date book or other written material.” Participants were asked, “Do you remember what your cholesterol number was?” If they did not answer “yes” and provide a number, they were asked to provide their best guess on the basis of their memory. The interviewer recorded whether or not this prod was used. The next question asked whether their cholesterol test result was in the desirable, borderline-high risk, or high risk category (469 recalled an exact cholesterol value, and 494 recalled a risk category). Finally, respondents were asked whether they had visited a physician regarding their cholesterol and whether they had made any changes to lower their cholesterol level (i.e., diet or exercise). After the interview, respondents received their actual test results and appropriate follow-up recommendations.

Results

Cholesterol Test Results

Total cholesterol levels ranged from 100 to 423 ($M = 206.2$, $SD = 50.8$). Most (46.0%) participants were in the desirable range ($M = 162.2$, $SD = 25.8$), with the rest distributed across the borderline-high risk (28.2%; $M = 218.0$, $SD = 11.4$) and high-risk categories (25.8%; $M = 271.6$, $SD = 28.5$).

Recall Accuracy for Total Cholesterol and Risk Category

Across all follow-up conditions, 38% of the participants accurately recalled their exact cholesterol score. As expected, recall accuracy declined across follow-up intervals: accuracy was 47.6%, 34.2%, and 31.3% across the 1-, 3-, and 6-month follow-up groups, respectively ($\zeta = -2.97$, $p < .01$). Accuracy was higher at 1 month versus the 3- ($\zeta = -2.42$, $p < .05$) and 6-month ($\zeta = -2.92$, $p < .01$) follow-up groups.

We also examined error rates by classifying as accurate responses within ±10 mg/dL (Murdoch & Wilt, 1997). On the basis of this 20-point range criterion, 83.5% of participants in the 1-month follow-up group, 72.9% of the participants in the 3-month follow-up group, and 66.7% of the participants in the 6-month follow-up group accurately recalled their cholesterol level ($\zeta = -3.41$, $p < .01$). Again, the 1-month group showed significantly
better recall than both the 3- (z = −2.29, p < .05) and 6-month (z = −3.41, p < .01) groups.

For cardiovascular disease risk categories (desirable, borderline-high risk, high risk), 88.7% of participants accurately recalled their risk category across all three recall periods. Unlike memory for cholesterol scores, recall accuracy for one’s risk category remained relatively high across the 1-, 3- and 6-month follow-up groups (89.9%, 89.4% and 86.7%, respectively; z = −0.13–0.92, ps > .35).

**Recall Bias**

If recall inaccuracy is unbiased, people should be equally likely to over- and underestimate cholesterol levels and risk. Conversely, biased recall would be characterized by a greater tendency to recall lower values and risk categories. We evaluated recall bias by comparing the proportion of those underestimating their cholesterol level with chance, dealt with the proportion reporting lower than actual cholesterol and the expected value of .50 (Bruning & Kintz, 1987; Uitenbroek, 1997). The distribution of the recall of cholesterol level, across all follow-up groups and within each follow-up group, appears in Table 1.

As predicted, a greater number of participants recalled their cholesterol level as lower than what they actually received. For exact cholesterol recall, the percentage of underestimators was greater than expected by chance for all comparisons except the 1-month follow-up interval (z > 3.00, ps < .01; see Table 1). A similar bias was manifested in recall of cardiovascular disease risk categories, with statistically significant differences in the 1-month (z = 2.67, p < .01) and 3-month (z = 2.67, p < .01) conditions, as well as when all participants were aggregated across follow-up intervals (z = 3.21, p < .01).

**Level of health threat and recall bias.** Participants in the high-risk group consistently underestimated their actual cholesterol across all follow-up groups and within each follow-up group (z = 1.4–4.9, ps < .05). Table 2 shows that in the 1-month group, for example, 55.3% recalled a lower (healthier) level, whereas only 2.6% recalled a higher level. Similar bias was observed across the other risk levels and follow-up periods, but comparisons were significant only for those with desirable cholesterol levels at the 6-month interval and when aggregated across all intervals (see Table 2).

The relationship between biased recall and threat level was manifested not only in the frequencies of different types of errors, but also in the mean differences between recalled and actual cholesterol levels. We found a significant linear relationship between the size of the discrepancy in participants’ recall and their risk category. F(1, 466) = 4.57, p < .05, r = .10, such that the higher the participant’s risk category, the greater the magnitude of bias toward remembering lower than actual cholesterol (see Figure 1). Therefore, both categorical and continuous measures of recall error revealed a pattern consistent with a self-enhancement process. Although a majority (54%) of participants reported efforts to reduce cholesterol (primarily via diet and exercise), the presence or absence of such efforts was unrelated to continuous recall bias (M = −7.5, SD = 29.8 vs. M = −6.4, SD = 22.8, respectively), t(465) = 0.46, p = .64, r = .02. However, higher categorical risk was associated with behavioral efforts to lower cholesterol, odds ratio = 1.95, 95% confidence interval = 1.14, 3.34, p < .05.

**Memory strength and recall bias.** As a simple behavioral measure of memory accessibility, we compared difference scores across participants who immediately responded to the cholesterol recall question with those who were prodded by the interviewer to provide an answer. Recall bias was larger in the prodded group (M = −14.3, SD = 41.5, n = 54) than in the unprodded group.

<table>
<thead>
<tr>
<th>Recall interval</th>
<th>Higher than actual</th>
<th>Accurate</th>
<th>Lower than actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>f</td>
<td>%</td>
<td>f</td>
</tr>
<tr>
<td><strong>Recall of exact cholesterol level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Across all follow-up groups**</td>
<td>21.7</td>
<td>102</td>
<td>38.0</td>
</tr>
<tr>
<td>1-month follow-up**</td>
<td>14.0</td>
<td>23</td>
<td>47.6</td>
</tr>
<tr>
<td>3-month follow-up</td>
<td>27.7</td>
<td>43</td>
<td>34.2</td>
</tr>
<tr>
<td>6-month follow-up**</td>
<td>24.0</td>
<td>36</td>
<td>31.3</td>
</tr>
</tbody>
</table>

| **Recall of cholesterol risk category** | | | |
| % | f | % | f | z* |
| **Across all follow-up groups** | 3.2 | 16 | 88.7 | 438 | 8.1 | 40 | 3.21 |
| 1-month follow-up** | 1.8 | 3 | 89.9 | 151 | 8.3 | 14 | 2.67 |
| 3-month follow-up** | 1.9 | 3 | 89.4 | 144 | 8.7 | 14 | 2.67 |
| 6-month follow-up | 6.1 | 10 | 86.7 | 143 | 7.3 | 12 | 0.43 |

Note. The percentage recalling lower than actual values or categories was compared to chance (p = .50). The p values for inaccurate responses are provided below.

a Binomial normal deviate test comparing only those with recall errors.

**p < .01.**
Because of heterogeneous variance, $F(53, 412) = 2.94$, $p < .01$, this comparison was not statistically significant, $t(57.8) = -1.43$, $p = .16$, $r = .18$.

Ancillary analyses. Recall bias (quantified by the difference between recalled and actual cholesterol) was not significantly associated with age, education, body mass index, cholesterol testing experience, cholesterol-related knowledge, positive affect, or negative affect. We found no second-order interactions among risk category, cholesterol testing experience, recall period, or gender variables. Recall bias was greater for men ($M = -9.5$, $SD = 29.5$) than for women ($M = -4.0$, $SD = 22.8$), $t(467) = 2.21$, $p < .05$, $r = .10$, even though their cholesterol values were similar ($M = 204.9$, $SD = 49.7$ and $M = 207.7$, $SD = 52.2$, respectively), $t(494) = -0.60$, $p = .30$. Participants were informed that male gender is an additional risk factor, and it is possible that this additional threatening information contributed to greater memory distortion among male participants. In sum, recall bias difference scores were predicted by gender, whereas gender and actual risk status predicted errors defined by a trichotomous (under, accurate, over) dependent variable.

Finally, we explored whether a healthy self-schema (e.g., “I am a healthy person”), as assessed by self-rated health, could explain biased recall of cholesterol test results (Kruglanski, 1996). Participants’ baseline health status ratings ($M = 3.67$, $SD = 0.96$) were uncorrelated with recall discrepancy scores, $r(450) = .02$, $p > .70$. A similar pattern was observed when the analysis was limited to those participants who received test results in the high risk range, $r(117) = -0.03$, $p > .77$, indicating that biases in recall were unrelated to self-rated health.

Discussion

To our knowledge, this is the first evaluation of the accuracy of recall for cholesterol test results in a standardized screening context that used the graded cardiovascular risk categories recommended by national guidelines. We found that memory for exact cholesterol values was poor, but memory for cardiovascular risk category was quite good. Accuracy for the former decreased over time, whereas accuracy for risk categories was insensitive to the recall interval. This accuracy is appreciably higher than has been found with validity estimates that use medical records of unstandardized screening events (Martin et al., 2000; Robinson et al., 1997; St. Sauver et al., 2005) as well as nominal validation studies that assessed lipids after assessing self-reported high cholesterol (Bowlin et al., 1993, 1996; Natarajan et al., 2002). Although we cannot completely rule out patient characteristics, it is likely that high accuracy for cardiovascular risk categories in this study was due to the consistent counseling following testing and to the correspondence between counseling labels and our operational definition of recall accuracy.

Despite substantial efforts to communicate the meaning and significance of cholesterol results, there were recall errors, and those errors occurred in a biased, self-enhancing manner. Biased

Table 2
Percentages and Frequency of Recall Errors for Exact Cholesterol Results by Risk Category

<table>
<thead>
<tr>
<th>Cholesterol recall</th>
<th>Higher than actual</th>
<th>Accurate</th>
<th>Lower than actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk category</td>
<td>%</td>
<td>f</td>
<td>%</td>
</tr>
<tr>
<td>Across all follow-up groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desirable*</td>
<td>23.5</td>
<td>50</td>
<td>39.4</td>
</tr>
<tr>
<td>Borderline high</td>
<td>24.1</td>
<td>52</td>
<td>42.1</td>
</tr>
<tr>
<td>High**</td>
<td>16.3</td>
<td>20</td>
<td>30.9</td>
</tr>
<tr>
<td>1-month follow-up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desirable</td>
<td>17.7</td>
<td>14</td>
<td>49.4</td>
</tr>
<tr>
<td>Borderline high</td>
<td>17.0</td>
<td>8</td>
<td>48.9</td>
</tr>
<tr>
<td>High**</td>
<td>2.6</td>
<td>1</td>
<td>42.1</td>
</tr>
<tr>
<td>3-month follow-up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desirable</td>
<td>30.6</td>
<td>22</td>
<td>33.3</td>
</tr>
<tr>
<td>Borderline high</td>
<td>29.5</td>
<td>13</td>
<td>38.6</td>
</tr>
<tr>
<td>High*</td>
<td>26.5</td>
<td>8</td>
<td>30.8</td>
</tr>
<tr>
<td>6-month follow-up</td>
<td></td>
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<td>Desirable*</td>
<td>22.6</td>
<td>14</td>
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<td>26.2</td>
<td>11</td>
<td>38.1</td>
</tr>
<tr>
<td>High*</td>
<td>23.9</td>
<td>11</td>
<td>21.7</td>
</tr>
</tbody>
</table>

Note. The percentage recalling lower than actual cholesterol values was compared to chance ($p = .50$). The $p$ values for inaccurate responses are provided below.

2 Proportions for sensitivity, specificity, positive predictive value, and negative predictive value for desirable versus combined borderline and high risk were 0.94, 0.97, 0.98, and 0.93, respectively. Among actual risk categories, 6 of 228 individuals with desirable cholesterol levels recalled their risk as borderline; 15 of 139 borderline risk recalled desirable risk, but 10 recalled high risk; and 24 of 127 with high risk recalled borderline risk, and 1 recalled desirable risk.
recall was most pronounced for recall of exact cholesterol values and less so for the more clinically significant cardiovascular risk categories. Further, this bias was strongest among those who received the most unfavorable test results, and this pattern persisted within and across follow-up intervals. Participants who initially reported difficulty in recalling their test results reported memories that were more self-enhancing than did individuals who did not report such difficulty, suggesting that less accessible memories are more susceptible to this bias.

The increase in memory distortion as a function of the level of health threat posed by the information indicates that the self-enhancement bias in memory is exacerbated by the relative unfavorability of the stimuli to which the person is exposed. However, this effect appears to be embedded within a general tendency to distort information in a way that is favorable to the self. This more general bias is reflected in the finding that all participants, even those with desirable cholesterol test results, showed a tendency to remember their health status as being better than it actually was. If recall biases had been caused by regression to the mean, then we would have expected individuals with lower cholesterol levels to have recalled levels that were somewhat higher than those obtained—in other words, levels that were closer to the mean.

Of course, the recall bias observed here may take on a different form in contexts that involve additional screening tests, different health behaviors, or subgroups with different demographic or health characteristics. For example, young adults showed a self-enhancing bias in that their retrospective recall of condom use during intercourse was higher compared with the same reports assessed via a daily diary (Garry, Sharman, Feldman, Marlatt, & Loftus, 2002). A similar bias involving more favorable recall of genetic lung cancer risk feedback among low-income African American smokers was reported by Lipkus et al. (2004). However, in that study, the majority of those tested (60%) did not recall or understand their test result, which may have been exacerbated by the lack of education and generally poor health of the sample. Because accuracy of cardiovascular risk recall was fairly good in our screening context, the consistent pattern of biased recall observed suggests a psychological process that is resistant to the advantages of education and good health. In surveillance for major health risk factors at the population level, we would certainly expect processes other than bias (see above) to affect recall accuracy.

This evidence for the role of self-enhancement in health-related memory complements other literature demonstrating the role of self-enhancement in health-related judgments (Croyle, 1990; Croyle, Sun, & Hart, 1997; Ditto & Croyle, 1995). For example, positive risk factor test results cause people to perceive the test as less valid and the risk factor as less serious and more common when compared with individuals who are told that their test is negative (Croyle & Ditto, 1990). Croyle, Sun, and Louie (1993) reported both experimental and observational evidence that cholesterol screening participants engaged in psychological minimization (e.g., lower ratings of the seriousness of high cholesterol) soon after being informed of undesirable test results. Similar distortion has also been observed for blood pressure readings (Croyle, 1990). In a diary study, hypertensive participants were more likely to log blood pressure values lower than those displayed (and surreptitiously recorded) by the blood pressure monitor (Johnson, Partsch, Rippole, & McVey, 1999). Thus, self-enhancing biases have been observed for self-reports of two major cardiovascular risk factors in both immediate and substantially delayed time intervals. Further investigation of the nature and scope of these biases is warranted.

It remains to be determined whether the biases in health threat appraisal and memory observed in our research are maladaptive. Building on Taylor and Brown’s (1988) earlier review, Armor and Taylor (1998) have argued that optimistic and self-enhancing appraisals are not only adaptive psychologically but may improve health outcomes in chronic and life-threatening illness (e.g., Reed, Kemeny, Taylor, Wang, & Visscher, 1994). Suggestive evidence exists in the cholesterol-screening literature that denial of risk can be a double-edged sword. In an evaluation of a worksite screening program, Irvine and Logan (1994) found that among men who were diagnosed with high cholesterol, those who later thought that their cholesterol was normal were less distressed but were also less likely to have healthy diets than men who reported having high cholesterol. However, that study assessed current perceptions of high cholesterol status rather than recall of feedback from the earlier screening event and therefore did not clearly address the effects of diagnostic labeling on health behaviors. Conversely, other work has revealed a generally positive effect of screening, irrespective of risk category. For example, Hyman, Flora, Reynolds, Johannsson, and Farquhar (1991) observed dietary improvements for all participants 3 months after cholesterol screening, but in another study, higher risk individuals were more likely to see a physician after screening (Gordon, Klag, & Whelton, 1990). In this vein, we found no difference in the average size of recall bias across self-reported cholesterol-lowering efforts or physician follow-up, but efforts to change behaviors were related to risk status. Given the relatively small number of people who inaccurately recalled their risk category, it seems that these distortions are not sufficient to alter behavioral reports of changes in diet and physical activity. Future research with objective measures of health behaviors could determine whether their presence and efficacy are related to biased recall.

Despite the memory errors and biases demonstrated here, it is important to emphasize that many of our research participants had accurate memories of the information provided to them. This is consistent with previous studies of errors and bias in cognition that noted that these phenomena are embedded in an adaptive system that, for the most part, displays an impressive degree of accuracy (Funder, 1987; Nisbett & Ross, 1980). Consistent with this view is our finding that among those participants who were interviewed up to 6 months after the cholesterol test, about one third recalled their exact cholesterol level correctly, but 89% accurately recalled their disease risk category. Because lipid management is largely based on risk category rather than specific cholesterol levels, the degree of error and bias shown by most of our participants should not

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3 We observed a nonsignificant association between recall bias and physician visits among participants who received cholesterol test results in the high-risk range (>239 mg/dL). Those who had consulted a physician about cholesterol manifested less bias ($M = -4.9, SD = 25.2$) than those who had not ($M = -14.4, SD = 34.7$), $t(99.23) = 1.71, p = .09, r = .16$, using separate variance estimates. Although this trend could be interpreted as evidence that recall bias undermined preventive health behavior, the fact that recall was assessed after the physician visit leaves open the possibility that the visit itself could have impacted recall.
affect their clinical management. However, this degree of accuracy was appreciably higher than that observed in other reports (Martin et al., 2000; Natarajan et al., 2002; Newell et al., 2000) and would represent a nontrivial proportion of adults screened in public health surveys. We attribute this accuracy in part to the consistent counseling provided to participants and believe that adhering to these counseling guidelines in the clinical setting (cf. Stafford et al., 1997) may improve the validity of self-reported cholesterol risk and reduce the adverse impact of risk factor labeling. In this regard, when those screened for hypertension have received close medical supervision and follow-up (e.g., in clinical trials; Harlan et al., 1986), hypertensive labeling has not affected perceived health, but in naturalistic settings lacking this attention, hypertensive labeling (but not hypertensive status) has been associated with perceptions of poorer health (Barger & Muldoon, 2006; Menz-Martín et al., 2003). These data are consistent with the idea that unwanted effects of screening and labeling can be offset by careful adherence to cardiovascular counseling and risk reduction guidelines.

Our data show that in a controlled clinical setting with consistent counseling, adults are generally accurate at recalling cholesterol risk levels across 1-, 3-, and 6-month recall periods but show a considerable self-enhancement bias when recalling actual test values. Accuracy for the former was largely unaffected by time elapsed following screening, whereas accuracy for the latter decreased over time. A similar but smaller self-enhancement bias was observed for risk categories, but these appear to be of lesser clinical relevance in light of the relatively low prevalence of errors. Self-reports of cardiovascular risk testing results are central to U.S. public health surveillance efforts (National Cholesterol Education Program, 2002; U.S. Department of Health and Human Services, 2000), and understanding determinants of their validity remains an important research area. We hope that the present study provides a clearer understanding of the factors that influence accuracy and that it underscores the importance of following recommended counseling guidelines, both to improve the validity of self-reported health risk status and to provide those screened with the means to reduce their risk.

References


