Less Is More in Presenting Quality Information to Consumers

Ellen Peters
Nathan Dieckmann
Decision Research, Eugene
University of Oregon, Eugene
Anna Dixon
Judith H. Hibbard
University of Oregon, Eugene
C. K. Mertz
Decision Research, Eugene

Much effort has been put into improving measures of health care quality. Although early research suggested that consumers made little use of quality reports, most reports were based on nonstandardized measures and were not user friendly. Information presentation approaches, however, will have a significant influence on what information is attended and used. The present research examines whether information presentation methods differentially influence consumers who differ in numeric skills. Results of three studies support the idea that “less is more” when presenting consumers with comparative performance information to make hospital choices. Results were particularly strong for those lower in numeracy, who had higher comprehension and made better choices when the information-presentation format was designed to ease the cognitive burden and highlight the meaning of important information. These findings have important implications for the sponsors of comparative quality reports designed to inform consumer decision making in health care.

Keywords: quality measures; numeracy; information presentation; decision making; comprehension

Much effort has been put into expanding and improving measures of health care quality. Heightened incentives for reporting have led to a growing volume of reported performance data on hospitals, nursing homes, and group practices. For

Authors’ Note: This article, submitted to Medical Care Research and Review on April 14, 2006, was revised and accepted for publication on August 8, 2006.

This material is based on work supported by the Blue Cross Blue Shield Association and by the National Science Foundation under Grant No. SES-0517770. Many thanks to Paul Slovic for extensive discussions on these and related studies.
example, under the Medicare Modernization Act 2003 (MMA), acute hospital care
payment updates have been linked to submission of data on 10 quality measures
since 2005 (Centers for Medicare and Medicaid Services [CMS] 2004). Incentives
for providers to report quality measures in ambulatory care are likely to follow.1
As a result of an agreement reached in February between the American Medical
Association (AMA) and Congress, data on individual physician performance mea-
sures will be available by the end of 2006. The AMA plans to develop approximately
140 measures covering 34 clinical areas (Pear 2006).

Comparative performance data are increasingly available to the public on Web sites
such as http://www.hospitalcompare.hhs.gov (Department of Health and Human
Services 2006) and http://www.medicare.gov (CMS 2006). Earlier research suggested
that consumers made little use of quality reports (Marshall et al. 2000). At the time,
however, most reports were based on nonstandardized measures, drew on a variety of
sources, and, in many cases, were not user friendly (Consumer Reports 2003). Since
then, there has been much activity in standardizing measures and establishing national
reporting requirements. There is still more to be done to improve the presentation of
comparative quality information and enhance its usability for consumers.

Conceptual Model

Most presentations of comparative information are based on the assumption that
consumers know what is important to them and where their self-interest lies. For
example, it is usually assumed that people have fixed ideas about what is important in
health care quality, and they can pick and choose from among different performance
measures displayed in a comparative report. However, both theory and evidence sug-
gest that these assumptions are faulty (Slovic 1995). The theory of constructed prefer-
ences posits that, when people are in a situation that is both complex and unfamiliar
(such as that of consumers using health care information), they likely do not have fixed
ideas about what is important to them. When asked about preferences, consumers will
provide an answer, but those answers are constructed, or thought up, at the moment the
question is posed. These constructed answers are not stable and will vary depending on
how the questions are asked or what information is provided (Lichtenstein and Slovic
2006). Findings from focus group studies with health care consumers suggest that pref-
erences are not stable, and preference shifts have been observed within the time frame
of a focus group (Hibbard and Jewett 1996; Hibbard and Pawlson 2004; Hibbard,
Sofaer, and Jewett 1996; Sainfort and Booske 1996; VHA Inc. 2000).

An important implication of the theory of constructed preferences is that when
preferences are not stable, information presentation approaches will have a signifi-
cant influence on what information is attended and used. That is, when people are in
a situation in which they must sort through complex, unfamiliar, and important fac-
tors to make a choice, how that information is framed and packaged will determine
to a large degree what information is actually used in choice. Consumers using
comparative health care information appear to be in just such a situation. Research has demonstrated that information presentation methods designed to assist consumer decision making can be used to reduce the cognitive demands made by presented information to help consumers understand the experience of choice and to highlight the meaning of information (Hibbard and Peters 2003).

There is growing evidence of the efficacy of easier-to-evaluate data displays under controlled conditions. A number of experimental studies have manipulated the presentation of quality information (making it easier to evaluate the good or bad meaning of the information) and measured the effects on decision making in health care. For example, the use of visual cues led decision makers to choose the highest-quality plan significantly more often than when presented with only a bar chart. Ordering plans according to quality within cost strata resulted in twice as many quality-maximizing choices than when the plans were unordered (Hibbard et al. 2002). In a real-world setting, a comparative hospital performance report was designed using easier-to-evaluate data displays and disseminated in south-central Wisconsin. An evaluation of the impact indicated that the report significantly changed consumer views about the differences in quality among hospitals (Hibbard, Stockard, and Tusler 2003). Overall, the evidence suggests that how information is presented can be as influential as what information is presented when attempting to inform health care choices.

Research has also demonstrated that information presentation methods do not have an equal effect on all consumers. For example, older adults find it more difficult to use information in decision making, and make more decision errors than the nonelderly adult population when presented with health plan information (Hibbard et al. 2001).

**New Contribution**

A significant percentage of the American population is innumerate or lacking in numeric skills. Based on the National Adult Literacy Survey, about 50% of Americans lack what are considered the minimal mathematical skills needed to make use of numbers embedded in printed materials (Kirsch et al. 2002). This study extends the existing literature in two important directions. First, it explores the importance of numeracy skill as a distinct skill area necessary for understanding and using health information. Almost all the research to date on consumer comprehension of health information has focused on measures of health literacy. These studies typically do not examine the elements of reading and numeric literacy separately. Second, the research examines alternative approaches for displaying information that may improve the comprehension of those with lower numeracy skill. The present research builds on previous work in psychology demonstrating that how numeric information is presented differentially influences decision makers who differ in numeric skills (Peters et al. 2006). Some people believe that the less numerate will not do much with numerical information, however well it is presented
We propose and test the idea that all consumers, but the less numerate in particular, will benefit from information producers paying careful attention to the potential cognitive burden imposed by comparative data, reducing this burden when possible, and highlighting the meaning of important information. We test the concept of “less is more” in three ways.

Research Questions

1. Will deleting less important information (i.e., providing only the most important quality information) increase comprehension and use of quality information?
2. Will making only the most important quality information easier to evaluate increase comprehension and the likelihood that it is actually used to inform a choice?
3. Will scaling quality numbers in accordance with cognitive expectations—so that higher numbers mean better performance (rather than worse performance)—result in greater comprehension and use of information?
4. For each of the above three research questions, will the concept of “less is more” have a larger influence on those consumers lower in numeracy compared to those higher in numeracy?

Overview of Method

A convenience sample \((N = 303)\) of employed-age adults (18 to 64 years old; mean age = 37; 48% female; 76% white) participated in the study. Respondents were recruited using fliers posted in the community and advertisements in a local newspaper; recruitment efforts were focused in areas of the community known to have lower levels of education to ensure a broad range of numeric ability. Half of the sample had lower levels of education (i.e., a high school degree or less); the other half had higher educational levels (i.e., at least some trade school or college). Only 45% of the sample had health insurance and 74% had annual household incomes of less than $20,000. The survey packet took an average of about 1 hour to complete. Each participant received $20 for completing the survey.

The following three studies focus on the presentation and formatting of numeric information. Participants were randomly assigned to view easier-to-evaluate information formats or to view information formats more commonly used in comparing hospitals or health insurance choices.

In addition, participants were asked to respond to a numeracy test that assesses people’s ability to convert percentages to proportions, proportions to percentages, and probabilities to proportions and to perform tasks on risk magnitudes and proportions (e.g., select the larger number). In the DR Numeracy Test (see Table 1), we used 11 items from Lipkus, Samsa, and Rimer (2001) and added 4 more complex numeric problems to the original scale for a total possible correct of 15 and to improve the
### Table 1
Results of the DR Numeracy Test: Overall and in Higher- and Lower-Education Groups

<table>
<thead>
<tr>
<th>Item</th>
<th>Question</th>
<th>% Correct</th>
<th>Lower Education</th>
<th>Higher Education</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Overall</td>
<td>Education (N = 303)</td>
<td>Education (n = 136)</td>
</tr>
<tr>
<td>Q5</td>
<td>Which of the following numbers represents the biggest risk of getting a disease? (1%, 10%, or 5%)</td>
<td>92</td>
<td>88</td>
<td>96</td>
</tr>
<tr>
<td>Q11</td>
<td>Which of the following numbers represents the biggest risk of getting a disease? (1 chance in 12 or 1 chance in 37)</td>
<td>90</td>
<td>86</td>
<td>93</td>
</tr>
<tr>
<td>Q4</td>
<td>Which of the following numbers represents the biggest risk of getting a disease? (1 in 100, 1 in 1,000, or 1 in 10)</td>
<td>89</td>
<td>83</td>
<td>94</td>
</tr>
<tr>
<td>Q8a</td>
<td>If the chance of getting a disease is 10%, how many people would be expected to get the disease: Out of 100?</td>
<td>84</td>
<td>74</td>
<td>93</td>
</tr>
<tr>
<td>Q9</td>
<td>If the chance of getting a disease is 20 out of 100, this would be the same as having a _____% chance of getting the disease.</td>
<td>81</td>
<td>70</td>
<td>90</td>
</tr>
<tr>
<td>Q8b</td>
<td>If the chance of getting a disease is 10%, how many people would be expected to get the disease: Out of 1,000?</td>
<td>78</td>
<td>69</td>
<td>86</td>
</tr>
<tr>
<td>Q6</td>
<td>If Person A's risk of getting a disease is 1% in 10 years, and Person B's risk is double that of A's, what is B's risk?</td>
<td>70</td>
<td>59</td>
<td>80</td>
</tr>
<tr>
<td>Q7</td>
<td>If Person A's chance of getting a disease is 1 in 100 in 10 years, and person B's risk is double that of A, what is B's risk?</td>
<td>64</td>
<td>49</td>
<td>76</td>
</tr>
<tr>
<td>Q1</td>
<td>Imagine that we roll a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up even (2, 4, or 6)?</td>
<td>58</td>
<td>50</td>
<td>65</td>
</tr>
<tr>
<td>Q13</td>
<td>Imagine that you are taking a class and your chances of being asked a question in class are 1% during the first week of class and double each week thereafter (i.e., you would have a 2% chance in Week 2, a 4% chance in Week 3, an 8% chance in Week 4). What is the probability that you will be asked a question in class during Week 7?</td>
<td>57</td>
<td>38</td>
<td>73</td>
</tr>
<tr>
<td>Q2</td>
<td>In the Big Bucks Lottery, the chances of winning a $10 prize are 1%. What is your best guess about how many people would win a $10 prize if 1,000 people each buy a single ticket from Big Bucks?</td>
<td>49</td>
<td>36</td>
<td>60</td>
</tr>
</tbody>
</table>

(continued)
distributional properties of the scale (see Q11 through Q14 in Table 1). To characterize numeracy, we regressed numeracy scores onto demographic items and indicators of health care experience. Higher numeracy was significantly associated with greater
education, being white, and being male; age, household income, the number of doctor
visits in the past year, the number of chronic diseases the respondent has, and having
health insurance were not significant independent predictors. In analyses, we exam-
ined whether individuals lower in numeracy based on a median split (0 to 9 correct)
differed from those higher in numeracy (10 to 15 items correct) on questions concern-
ing comprehension and choices of higher-quality hospitals.

Study 1

In this study, we examined whether ordering information from more to less
important and deleting less important information would improve comprehension
and lead to more choices of higher-quality hospitals. All respondents saw cost infor-
mation and four indicators of hospital quality: (1) percentage of time guidelines for
heart attack care are followed, (2) percentage of time guidelines for pneumonia care
are followed, (3) number of registered nurses per 100 patients, and (4) the presence
of a computer system to prevent medication errors. Depending on the provided
information format, some respondents also saw nonquality information (the number
of general care beds, rated quality of hospital food, the number of visiting hours per
day, and the availability of patient references). Comprehension questions concerned
cost and quality indicators only.

Hypotheses

1. Deleting nonquality information will improve comprehension.
2. Deleting nonquality information will lead to more choices of higher-quality
   hospitals.
3. Ordering and highlighting quality information will have similar but smaller effects.
4. Respondents lower in numeracy will show larger effects than those higher in
   numeracy.

Method

Respondents were randomly assigned to one of three formats for presenting hospi-
tal quality information. In the first format, information about cost, quality indicators,
and nonquality information was unordered (see Table 2). In the second format, the same
information was shown ordered with cost and quality information first and highlighted
(and nonquality information last). In the third format, quality and cost information only
were shown with quality information highlighted (the nonquality information was
deleted; see Table 3). In each condition, respondents were shown information about
three hospitals and were asked to choose a hospital and answer a series of questions
about the information they were shown. The three hospitals were structured so that
Hospital Y was the highest-cost, highest-quality hospital, whereas Hospital X was the lowest-cost, lowest-quality option in each condition. Respondents were asked which hospital they would choose if they needed care. Respondents also responded to three comprehension questions about costs and indicators of hospital quality: Which hospital is most expensive for you? Which hospital is most likely to follow the guidelines for heart attack care? Which hospital has the least registered nurses per 100 patients? No questions were asked about nonquality information because not all respondents saw this information (i.e., those in the quality-and-cost-only condition did not see it).

### Results

**Comprehension.** A $2 \times 3$ analysis of variance (ANOVA) was used to assess the effects of numeracy (low, high) and presentation format (unordered, ordered, and

### Table 2

**Study 1: Unordered—Both Quality and Nonquality Hospital Information Is Presented Unordered**

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Hospital X</th>
<th>Hospital Y</th>
<th>Hospital Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your out-of-pocket costs</td>
<td>$</td>
<td>$$$</td>
<td>$</td>
</tr>
<tr>
<td>No. of general care beds</td>
<td>550</td>
<td>231</td>
<td>180</td>
</tr>
<tr>
<td>Rated quality of hospital food (higher is better)</td>
<td>4.1</td>
<td>1.1</td>
<td>2.0</td>
</tr>
<tr>
<td>% of time guidelines for heart attack care are followed</td>
<td>82%</td>
<td>92%</td>
<td>87%</td>
</tr>
<tr>
<td>% of time guidelines for pneumonia care are followed</td>
<td>60%</td>
<td>89%</td>
<td>78%</td>
</tr>
<tr>
<td>No. of visiting hours per day</td>
<td>11</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>No. of registered nurses per 100 patients</td>
<td>18</td>
<td>38</td>
<td>29</td>
</tr>
<tr>
<td>Patient references available</td>
<td>Limited</td>
<td>Limited</td>
<td>Limited</td>
</tr>
<tr>
<td>Has computer system to prevent medication errors</td>
<td>No</td>
<td>Yes</td>
<td>Limited</td>
</tr>
</tbody>
</table>

### Table 3

**Study 1: Quality and Cost Only—Hospital Information Includes Quality Information Only and Is Highlighted**

<table>
<thead>
<tr>
<th>Measures</th>
<th>Hospital X</th>
<th>Hospital Y</th>
<th>Hospital Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your out-of-pocket costs</td>
<td>$</td>
<td>$$$</td>
<td>$</td>
</tr>
<tr>
<td>No. of registered nurses per 100 patients</td>
<td>18</td>
<td>38</td>
<td>29</td>
</tr>
<tr>
<td>Has computer system to prevent medication errors</td>
<td>No</td>
<td>Yes</td>
<td>Limited</td>
</tr>
<tr>
<td>% of time guidelines for heart attack care are followed</td>
<td>82%</td>
<td>92%</td>
<td>87%</td>
</tr>
<tr>
<td>% of time guidelines for pneumonia care are followed</td>
<td>60%</td>
<td>89%</td>
<td>78%</td>
</tr>
</tbody>
</table>

Hospital Y was the highest-cost, highest-quality hospital, whereas Hospital X was the lowest-cost, lowest-quality option in each condition. Respondents were asked which hospital they would choose if they needed care. Respondents also responded to three comprehension questions about costs and indicators of hospital quality: Which hospital is most expensive for you? Which hospital is most likely to follow the guidelines for heart attack care? Which hospital has the least registered nurses per 100 patients? No questions were asked about nonquality information because not all respondents saw this information (i.e., those in the quality-and-cost-only condition did not see it).
quality and cost only) on comprehension. Comprehension was highest when only the most relevant quality information was shown such that respondents correctly answered (out of the 3 possible comprehension items) 2.4, 2.6, and 2.8 questions correctly in the three conditions, respectively, $F(2, 298) = 6.4, p < .01$. Comprehension in the quality-and-cost-only condition was significantly better than in the unordered condition, $F(1, 298) = 12.8, p < .001$. No other pairs of conditions were significantly different. Respondents high in numeracy comprehended more than those low in numeracy. The mean number of items answered correctly (out of 3 possible) was 2.8 and 2.3 for those high and low in numeracy, respectively, $F(1, 295) = 54.5, p < .001$.

In addition, those low in numeracy were helped significantly more by the presentation format than those high in numeracy: interaction effect $F(2, 295) = 3.4, p < .05$ (see Figure 1). Comprehension of subjects low in numeracy was significantly improved in both the ordered and quality-and-cost-only conditions compared to the unordered condition, $F(1, 130) = 7.1$ and $13.5$, respectively, $p < .01$. Comprehension of high-numerate subjects showed significant improvement in the quality-and-cost-only condition compared to the unordered condition, $F(1, 165) = 7.1, p < .01$.

Choice. An ANOVA model was used to assess the effects of presentation format and numeracy on choice. In this analysis, choice is a binary variable indicating whether the highest-quality Hospital Y was chosen. The $F$ statistic from an ANOVA

Figure 1
Study 1. Mean Comprehension by Presentation Format and Numeracy

![Figure 1](image-url)
has been shown to give accurate—and conservative—results for large samples of a dichotomous dependent variable (Snedecor and Cochran 1967). 62% of respondents chose the highest-quality Hospital Y when only the quality information was shown, compared to 48% who chose Hospital Y in the ordered condition and 40% who chose it when the information was unordered, $F(2, 297) = 5.0, p < .01$. Choices of the highest-quality hospital were significantly higher in the quality-and-cost-only condition compared to the other two conditions that did not differ significantly from one another (quality-and-cost-only condition versus unordered condition, $F[1, 300] = 10.2, p < .01$; quality-and-cost-only condition versus the ordered condition, $F[1, 300] = 4.2, p < .05$). The main effect of numeracy and its interaction with condition were not significant (see Figure 2).

Summary

Results from Study 1 support the idea that “less is more” when presenting consumers with comparative performance information to make hospital choices. With less information, respondents were better able to comprehend important cost and quality information, and they were more likely to choose a higher-quality hospital. Results were particularly strong for those lower in numeracy who comprehended much more when less information was shown. This experiment provided a strong
test of the hypothesis because those respondents who chose the higher-quality hospital did so despite its higher cost. In the real world, higher-quality hospitals do not necessarily cost more and, therefore, we might expect to see a greater impact.

**Study 2**

In this study, we examined whether using symbols to make numbers easier to evaluate would help respondents weigh quality of care for a specific condition more than a less important quality measure. We also examined whether making only the condition-specific measure easier to evaluate, as opposed to making both measures easier to evaluate, would help respondents give greater weight to the more important quality measure.

**Hypotheses**

1. Making only the more important condition-specific quality measure easier to evaluate will help both comprehension and choices (leading to more choices of higher-quality hospitals).
2. Respondents lower in numeracy will show larger effects than those high in numeracy.

**Method**

Respondents were told that they needed treatment for heart failure and were asked to choose among 15 hospitals based on cost, overall patient satisfaction (less important), and death rate for heart failure patients (more important). Hospital costs were always presented the same way (with dollar symbols). Hospital quality for both measures was shown numerically to all respondents. In addition, the numbers were made easier to evaluate in some formats. Respondents were randomly assigned to one of five formats for presenting the hospital quality information. In the first format, respondents saw numbers only (no measure was made easier to evaluate). In the second format, death rate (but not patient satisfaction) was made easier to evaluate using black and white symbols (see Table 4). In the third format, again only death rate was made easier to evaluate but with traffic-light symbols. In the fourth format, the numbers for both measures were made easier to evaluate using black and white symbols, and in the fifth format, numbers for both measures were made easier to evaluate using traffic-light symbols. The 15 hospitals were structured so that hospitals with higher death rates had higher patient satisfaction. One hospital in each of the three cost strata had the highest quality based on the death-rate measure (Hospitals E, D, and M).
Respondents were asked which hospital they would choose if they needed treatment for heart failure. Respondents also answered four comprehension questions: Which hospital has the highest death rate for patients being treated for heart failure? Which hospital has the lowest patient satisfaction with the hospital? If you need to go to the hospital, is it better to choose one with a low number for its death rate or a high number? If you need to go to the hospital, is it better to choose one with a low number for patient satisfaction or a high number?

Results

Comprehension. The five presentation formats did not have a significant overall influence on comprehension. Mean comprehension ranged from 3.4 to 3.6 out of a maximum possible of 4. Respondents high in numeracy comprehended more than those low in numeracy. The mean number of items answered correctly (out of 4 possible) was 3.8 and 3.1 for those high and low in numeracy, respectively, $F(1, 293) = 46.9, p < .001$.

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Cost</th>
<th>Overall Patient Satisfaction</th>
<th>Death Rate for Heart-Failure Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital E</td>
<td>$$$</td>
<td>68</td>
<td>1.4%</td>
</tr>
<tr>
<td>Hospital H</td>
<td>$$$</td>
<td>76</td>
<td>4.1%</td>
</tr>
<tr>
<td>Hospital B</td>
<td>$$$</td>
<td>81</td>
<td>4.8%</td>
</tr>
<tr>
<td>Hospital J</td>
<td>$$$</td>
<td>87</td>
<td>5.3%</td>
</tr>
<tr>
<td>Hospital K</td>
<td>$$$</td>
<td>90</td>
<td>6.1%</td>
</tr>
<tr>
<td>Hospital D</td>
<td>$$</td>
<td>71</td>
<td>3.9%</td>
</tr>
<tr>
<td>Hospital F</td>
<td>$$</td>
<td>78</td>
<td>4.4%</td>
</tr>
<tr>
<td>Hospital I</td>
<td>$$</td>
<td>85</td>
<td>4.9%</td>
</tr>
<tr>
<td>Hospital N</td>
<td>$$</td>
<td>90</td>
<td>6.1%</td>
</tr>
<tr>
<td>Hospital G</td>
<td>$$</td>
<td>94</td>
<td>6.6%</td>
</tr>
<tr>
<td>Hospital M</td>
<td>$</td>
<td>88</td>
<td>5.2%</td>
</tr>
<tr>
<td>Hospital A</td>
<td>$</td>
<td>91</td>
<td>6.4%</td>
</tr>
<tr>
<td>Hospital C</td>
<td>$</td>
<td>95</td>
<td>7.3%</td>
</tr>
<tr>
<td>Hospital O</td>
<td>$</td>
<td>96</td>
<td>8.9%</td>
</tr>
<tr>
<td>Hospital L</td>
<td>$</td>
<td>98</td>
<td>9.6%</td>
</tr>
</tbody>
</table>

Note: A key indicated that ● = better than average, ○ = average, and ○ = worse than average. For the conditions using traffic-light symbols, the three symbols above were systematically replaced with circles filled in with green, yellow, and red, respectively. The corresponding key looked like a traffic light.
**Choice.** A 2 (low/high numeracy) × 5 (presentation format) ANOVA was used to assess the effects of presentation format and numeracy on choice. In this analysis, choice is a binary variable indicating whether one of the lowest-death-rate hospitals was chosen. More respondents chose the lowest-death-rate hospital when only it was made easier to evaluate. Averaging across the two symbol types, 74% chose Hospital E, D, or M when only the death rates were made easier to evaluate compared to 60% when numbers only were presented, and 60% when symbols for both measures were included, $F(1, 298) = 5.0, p < .05$, for the difference between the conditions that used symbols for death rate only compared to symbols for both measures. Making only the most important information easier to evaluate helps the most in hospital choices of both the high and low numerate. Among those low in numeracy in the three conditions that showed numbers only, symbols for death rate only, and symbols for both measures, 61%, 66%, and 44% chose Hospital E, D, or M, respectively. Among respondents high in numeracy in the same three conditions, 59%, 79%, and 74% chose Hospital E, D, or M, respectively. Black and white versus colored traffic light symbols did not make a difference overall. The main effect of numeracy was significant with the high numerate choosing higher-quality hospitals more often than the low numerate, $F(1, 293) = 10.0, p < .01$.

The interaction of numeracy and condition was also significant, $F(4, 293) = 2.9, p < .05$ (see Figure 3). For example, the low numerate showed a stronger effect of using symbols for death rate only versus symbols for both measures compared to the high numerate, $F(1, 130) = 6.2, p < .01$, in analyses including only the low numerate; the same analysis did not reach significance for the high numerate. The high numerate did make significantly more high-quality choices with symbols for death rate only compared to numbers only, $F(1, 163) = 5.2, p < .05$. In addition, although there was no difference between traffic light and black and white symbols overall, these symbols did have differential effects on the high and the low numerate. The high numerate made more high-quality choices with the traffic light symbols compared to black and white symbols, $F(1, 163) = 4.5, p < .05$, whereas the low numerate made directionally more high-quality choices with the black and white as compared to the traffic light symbols (this difference was not significant for the low numerate).

**Summary**

The results demonstrated that how information is presented influences choices; they also further support the idea that “less is more” when presenting consumers with information to make hospital choices. Making only the more important measure easier to evaluate led to more choices of higher-quality hospitals. Comprehension was not influenced by condition, but there may have been an influence if we had asked more difficult questions. In this study, the small numbers for death rates could have contributed to indifference or a failure to discriminate among the hospitals. The symbols
may have amplified these differences and/or provided affective meaning to them. The study results also point out that information providers need to be careful in choosing symbols and must test their use in populations that vary in ability because symbols may have different effects. Printed symbols based on traffic lights, for example, helped the high numerate but may have hurt the low numerate. We believe that our grouping of the hospitals in threes may have mimicked the shape of a traffic light, but that because the order of the colors in each group did not match the color order for traffic lights, we unintentionally required additional cognitive effort to process this mismatch. The more numerate respondents appeared better equipped to handle the additional effort required.

**Study 3**

In Study 3, we examined whether presenting numerical information to be consistent with the direction of the number line (i.e., greater numbers represent more desirable scores as opposed to less desirable scores) and providing symbols along with numerical scores would improve comprehension and lead to more choices of higher-quality hospitals.
Hypotheses

1. The use of easier-to-evaluate symbols will help choice and comprehension.
2. Using numbers in a direction consistent with the number line (higher is better) will improve comprehension and increase choices of higher-quality hospitals.
3. These effects will be stronger for those lower in numeracy.

Method

Respondents were shown information about a measure of hospital quality (nurse-to-patient ratios) and costs for 15 hospitals. They were randomly assigned to see the hospital quality information in one of four formats (costs were always shown the same way using one to four dollar signs). In the first format called “higher is better” with symbols
(see Table 5), the quality measure is shown as the number of registered nurses per 100 patients (a higher number reflects better quality), and symbols are used to indicate whether the hospital has more nurses per 100 patients ☺, an average number ◇, or fewer nurses per 100 patients ☐. In the second format called “lower is better” with symbols, normatively equivalent information is shown in the reversed ratio of the number of patients per nurse (a lower number reflects better quality). Symbols again are shown to make the ratio easier to evaluate. In this case, the symbols are fewer patients per nurse ☐, average number of patients per nurse ◇, and more patients per nurse ☺. The final two formats do not use any symbols. One format was the ratio “higher is better,” the other uses “lower is better.” The 15 hospitals were structured so that Hospital A and Hospital M were the best choices within their respective cost strata. All other hospitals were inferior on either cost or patient-to-nurse ratio.

Respondents were asked which hospital they would choose if they needed care. They also responded to four comprehension questions: Which hospital has the greatest number of patients per registered nurse? (In the “lower is better” condition, they were asked about the fewest registered nurses per 100 patients). If cost were less important to you, which hospital would be your best choice? If cost were extremely important to you and you could afford very little, which hospital would be your best choice? Is it better for a hospital to have a greater number of patients per registered nurse or fewer? In the “higher is better” condition, they were asked about the number of registered nurses per 100 patients.

Results

Comprehension: A 2 (low/high numeracy) × 2 (lower/higher is better) × 2 (with/without symbols) ANOVA was used to assess the effects of presentation format and numeracy on comprehension. Respondents showed better comprehension of the hospital information in the “higher is better” condition as compared to the “lower is better” condition, $F(1, 292) = 13.4, p < .001$, such that respondents correctly answered (out of the 4 possible comprehension items) 3.1 and 2.7 questions correctly in the “higher is better” without symbols and “lower is better” without symbols conditions, respectively, and correctly answered 2.9 and 2.5 questions in the “higher is better” with symbols and “lower is better” with symbols conditions. The presence of symbols slightly hurt comprehension overall, although this effect was not statistically significant by conventional criterion, $F(1, 292) = 2.8, p < .10$. With respect to numeracy, the mean number of items answered correctly (out of 4 possible) was 3.3 and 2.2 for those high and low in numeracy, respectively, $F(1, 292) = 84.9, p < .001$.

In addition, presentation format had differential effects on comprehension for the high and low numerate, $F(1, 292) = 4.5, p < .05$ (see Figure 4). Respondents low in numeracy showed greater comprehension when information was presented in the
“higher is better” frame, $F(1, 128) = 10.8, p < .001$, regardless of whether symbols were present. Respondents high in numeracy did not show a significant difference in comprehension between the “higher is better” and “lower is better” frames, but they did show greater comprehension when symbols were not present, $F(1,164) = 4.2, p < .05$.

**Choice.** A $2 \times 2 \times 2$ ANOVA model was used to assess the effects of presentation format and numeracy on choice. In this analysis, choice is a binary variable indicating whether one of the two best hospitals was chosen. More respondents chose the best hospitals when information was presented in the “higher is better” frame (73%) than the “lower is better” frame (60%), $F(1, 292) = 7.0, p < .01$. The symbols did not make a significant difference in choices. Highly numerate respondents were more likely than low-numerate respondents to choose the best hospitals, $F(1, 292) = 27.8, p < .001$.

As with comprehension, presentation format had differential effects on choice for the high and low numerate, $F(1, 292) = 3.2, p = .07$ (see Figure 5). Respondents low in numeracy made more choices of the best hospitals when information was presented in the “higher is better” frame, $F(1, 128) = 5.1, p < .05$, regardless of whether symbols were present. Respondents high in numeracy also made more choices of the best hospitals when presented with the “higher is better” frame compared to the “lower is better” frame when the symbols were present, $F(1, 164) = 5.1, p < .05$, but were also able to choose the best hospitals in the “lower is better” condition as long as there were
not symbols present, $F(1, 164) = 4.4, p < .05$. The mismatch between the symbols (+ is good) and the lower numbers being better in this latter condition appeared to produce a comprehension problem that adversely affected choices for this group.

Summary

Results of the present study support the idea that presenting information in a “higher is better” frame that is consistent with how individuals think about and process numbers facilitates comprehension and helps consumers make better hospital choices. Results were particularly strong for those respondents lower in numeracy who comprehended more information and made more optimal choices with the “higher is better” frame. Results of this experiment also demonstrated that it is important to be consistent with the verbal framing and symbols used. For example, highly numerate respondents made fewer high-quality choices when a plus (+) sign was paired with a “lower is better” frame. It is also important to note that the symbols used in this experiment did not have much of an effect on choice and comprehension, except for an adverse effect when a mismatch existed between the symbol and verbal framing. This finding serves as a reminder that symbols need to be chosen carefully if they are to have the desired impact on choice and comprehension.
One caveat to our findings is that we used ratios (e.g., the number of registered nurses per 100 patients) and the use of ratios may be a particularly difficult concept. As a result, our findings may reflect not just the difficulty of understanding direction but also the cognitive difficulty of processing ratios. In addition, patients may not understand that this ratio is an important quality indicator. Our results suggest that when important indicators are not fully appreciated by consumers, greater attention to formatting may assist them in using the information nonetheless.

**Discussion**

Results of three studies support the idea that “less is more” when presenting consumers with comparative performance information to make hospital choices. In Study 1, with less information, respondents were better able to comprehend important cost and quality information, and they were more likely to choose a higher-quality hospital. In Study 2, making only the more important measure easier to evaluate leads to more choices of higher-quality hospitals. Finally, in Study 3, less cognitive effort was more; presenting information in a “higher is better” frame that is consistent with how individuals think about and process numbers facilitated comprehension and helped respondents make better hospital choices. Results were particularly strong for those lower in numeracy who had higher comprehension and made better choices when the information-presentation format was designed to ease the cognitive burden and highlight the meaning of important information. That said, results of Studies 2 and 3 point out that information providers need to be careful in choosing symbols to highlight meaning and must test their use in populations that vary in ability because symbols may have different effects. The printed traffic-light symbols of Study 2, for example, helped the highly numerate but hurt the low-numerate respondents.

These findings have important implications for the sponsors of comparative quality reports designed to inform consumer decision making in health care. Current policy trends mean that consumers are increasingly expected to choose between different health plans, hospitals, health care providers, and treatment options. For example, despite low levels of employee uptake of “consumer directed health plans” (Fronstin and Collins 2005), President Bush gave a clear signal in the State of the Union address of his administration’s intention to extend health savings accounts to more people (The White House 2006). The aim of these plans that combine high-deductible insurance coverage with a tax-free savings account is to give incentives to consumers to “shop” for the highest-quality health care at the lowest cost. Central to the success of these proposals is the ability of consumers and patients to use quality information and make informed choices. The concept developed in the present article that “less is more” when presenting comparative measures of hospital and provider performance will be critically important to the success of such approaches. As the number of people enrolled in plans that have a health savings account or a health reimbursement account rises, more consumers will comparison shop...
for health care. If these decisions are to be informed by quality as well as cost, then reports need to show only important quality measures (or at least highlight them), make them easier to evaluate (i.e., by using well-tested symbols), and present data in accordance with cognitive expectations (i.e., higher numbers mean better performance). For those with poor numeracy skills, the effect of information presentation on comprehension and choice is even more marked. Given that almost half of the general population would have difficulty with relatively simple numeric tasks, such as calculating the difference between regular and sales prices from an advertisement or estimating the cost per ounce of a grocery item (Kirsch et al. 2002), taking steps to present information in accord with these recommendations will reduce disparities in the ability to make high-quality health care decisions.

The experiments in this article were limited to comparisons of hospital quality, but it is likely that the findings are generalizable to comparative performance reports on nursing homes, health plans, and routine office visits to medical groups and individual physicians. The findings also could usefully inform the design of Web-based tools that generate comparative reports for consumers. For example, comparative data on the performance of medical groups (based on clinical measures) and doctor’s offices (based on patient experience reports) across Massachusetts have recently been made available to the public (www.mhqp.org). Summary measures of quality are presented (with the ability to drill down to detailed results), easier-to-evaluate labels are used (up to four stars for the highest performers), and all the measures are structured in such a way that higher values are better. Evaluating the use of these reports by different groups of health care consumers would enable the findings of this experimental research to be tested in a real-world setting.

Whether the findings of this study are also applicable to reports that compare nonroutine medical visits, the quality of plans, or the quality of particular products (e.g., drugs, aids and devices or the quality of treatment options) is unknown and needs further testing. Emerging evidence from the implementation of the Medicare Part D Drug Benefit suggests that Medicare beneficiaries are confused by the array of choices they face and find it difficult to compare plans (Hibbard, Greene, and Tusler 2006). A “less is more” approach to presentation of comparative plan data might well enable consumers to make more informed choices. Uptake of subsidized plans among low-income elders has been particularly low. This study would suggest that the lower levels of numeracy in this population may be a key determining factor in the ability to comprehend comparative quality information and use it to make choices. Results of this study suggest that this population can be greatly helped by simple changes in information presentation.

Study Limitations

The use of a convenience sample raises the question of the generalizability of the findings. The cognitive processes that produced the effects have been observed in
other studies examining a wide range of individuals and a diverse array of decision tasks. They are considered fundamental to the way that human beings think and process information. Thus, there is no reason to believe that the effects observed in this sample would vary widely from those observed in any other employed sample. In addition, our sample design called for stratification on education to obtain greater variability in numeracy. Results confirmed the suggestions of previous research (Hibbard et al. 2002) that higher ability would reduce the influence of presentation format variations on choices. Those with lower numeracy were more susceptible to the influence of changed presentation formats.

Finally, it is not always possible to measure numeracy as we did because of time limitations, phone surveys, and the anxiety engendered by a math test for some people. Developing a measure of consumers’ subjective capacity for understanding numbers as opposed to questions that measure their actual number ability is an important next step (Fagerlin et al. 2003). These questions can be used in consumer surveys to assess the influence that numeracy has on different types of consumer health care behavior or to guide consumers who likely differ in numeric ability to resources tailored to them.

**Note**

1. The Ambulatory Care Quality Alliance published a list of clinical performance measures in May 2005. The National Quality Forum (NQF)—in a joint effort by CMS, the National Committee for Quality Assurance (NCQA), and the American Medical Association (AMA)/Physician Consortium for Performance Improvement (Consortium)—has also endorsed a set of ambulatory measures.

**References**


