INTRODUCTION

Effective decision making in a variety of uncertain conditions is a daily challenge faced by adults of all ages. For instance, decisions to wear or not to wear uncomfortable safety goggles while painting, financial decisions to retain or sell company stock, and medical decisions to undergo surgery or chemotherapy are all situations in which outcomes are uncertain. Each of these decisions is risky and can be conceptualized as gambles on likely outcomes.

Although a number of heuristics and motivations associated with risky decision making have been identified (see Goldstein & Hogarth, 1997, for a review), the current study investigated the pervasiveness of the framing effect across cohort, time of testing, and age. Generally, the term framing effect refers to changes in one’s perceptions of the expected utility of decision options attributable to wording alterations that bias judgment. Specifically, a decision frame may be defined as “the decision maker’s conception of acts, outcomes, and contingencies associated with a particular choice. The frame that a decision-maker adopts is controlled partly by the formulation of the problem and partly by the norms, habits, and personal characteristics of the decision-maker” (Tversky & Kahneman, 1981, p. 453).

To illustrate how the simple rewording of decision options influences decision-making behavior, consider Tversky and Kahneman’s (1981) two variations on the Asian disease problem:

Problem 1.
Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimate of the consequences of the programs are as follows:
If Program A is adopted, 200 people will be saved.
If Program B is adopted, there is 1/3 probability that 600 people will be saved, and 2/3 probability that no people will be saved.
Which of the two programs would you choose?

Problem 2.
If Program C is adopted, 400 people will die. 
If Program D is adopted, there is 1/3 probability that nobody will die and 2/3 probability that 600 people will die.
Which of the two programs would you choose?

Notice that the decision options in Problem 1 are positively framed or worded as gains, whereas the options in Problem 2 are negatively framed as losses. In Problem 1, Program A reflects a sure gain of 200 lives, whereas Program B reflects an uncertain gamble that may result in a larger gain. In Problem 2, Program C reflects a sure loss of 400 lives, whereas Program D reflects an uncertain gamble that may result in a smaller loss. Thus the framing effect refers to the reversal of choice preferences when options are equivalent but worded differently as either gains or losses. For instance, Programs A and C are statistically equivalent, yet participants are more likely to choose Program A, (because it is a sure gain) than they are to choose Program C (which is a sure loss).

Choices framed as gains are often perceived as risk averse, such that people are willing to choose a sure gain (i.e., Program A) rather than gambling for the uncertain acquisition of a larger gain (i.e., Program B). Conversely, choices framed as losses are often perceived as risk taking, such that people are willing to gamble for an uncertain smaller loss (i.e., Program D) rather than accepting a sure loss (i.e., Program C).

Although the Asian disease problem illustrates that manipulation of information presentation may result in different decision behavior, the characteristics of the person making decisions are equally important in determining the effectiveness of the framing effect. Recent evidence suggests that individual differences such as cognitive ability (Stanovich & West, 1998) and gender (Fagley & Miller, 1997) influence susceptibility to framing in undergraduate samples. Because inconsistencies in framing appeared within relatively homogeneous samples of undergraduates, it appeared likely that framing and decision-making differences would be found among more heterogeneous samples.

For instance, consider the well-documented age-related changes in cognitive abilities such as memory, attention, and problem solving (see Craik & Salthouse, 2000, for a review). Given these highly variable cognitive changes that accompany normal aging, differences in susceptibility to framing may emerge between older and young adults. In fact, one meta-analysis identified chronological age as a participant characteristic that has not been systematically investigated in the framing literature; thus there is a theoretical motivation for conducting this research (Kuhberger, 1998).

The practical motivation for conducting this research is apparent when one considers that it is estimated that 77 million people in the United States will be over the age of 65 by the year 2040 (U.S. Bureau of the Census, 1996) and that decision making is a cognitive process exercised daily. Thus the paucity of research addressing aging and decision making is alarming (Sanfey & Hastie, 2000; Yates & Palatano, 1999). The discovery of age-related differences in susceptibility to framing might affect decision processes in a number of areas, such as advertising, medical education, and warnings compliance. Because framing may bias the risky decisions of older adults and therefore influence their daily lives, the present study was conducted to determine if the framing effect described by Tversky and Kahneman (1988) is replicable across time and if people of all ages are susceptible to the framing effect.

To address these issues, a number of comparisons were conducted to separate age effects from cohort and time-of-testing effects. Cohort effects were measured by comparing the Tversky and Kahneman benchmark (1988) data with data collected from a sample of young adults. Time-of-testing effects were measured by comparing the benchmark data with data collected from a sample of older adults. Suspected age-related differences in the effect of framing on decision making were evaluated by comparing data from the young and older adults. The implications of these findings are discussed in a number of practically relevant contexts.
**METHOD**

**Participants**

There were 58 young (mean age 20.3 years, \(SD = 3.2,\) range = 19–30) and 58 older (mean age 70.3 years, \(SD = 4.8,\) range = 60–79) participants in this experiment. The young participants were recruited from an undergraduate research participant pool and received partial course credit. The older participants were community-dwelling adults who were paid for their participation. Each participant was tested in a large group consisting of 10 or more participants.

Demographic and abilities information was collected for the sole purpose of describing the two samples. Demographic data were specifically obtained concerning self-reported health and education. Both groups of participants reported themselves to be in “good” health. Older adults had more years of formal education than did younger adults, \(t(107) = –3.89, p < .001.\) Because testing was conducted in large groups, a small number of the participants did not complete the abilities test battery or respond to various items on the demographics questionnaire. These participants were eliminated from the analyses of the self-reported years of formal education and abilities tests; thus the reported sample sizes denoted by the degrees of freedom are lower than 116.

Participants included in the analyses discussed in this paper completed the vocabulary subtest of the Shipley Institute of Living Scale (Shipley, 1986) and the Digit Symbol Substitution (DSS) and Reverse Digit Span subtests of the Wechsler Adult Intelligence Scale (Wechsler, 1997). As was expected, and is typical, older adults outperformed younger adults on the vocabulary test, but the reverse was true for the DSS and the Reverse Digit Span test. Older participants \((M = 54.8, SD = 5.4)\) performed significantly better than young participants \((M = 29.7, SD = 3.8)\) on the vocabulary test, \(t(101) = –5.58, p < .001.\) Young adults \((M = 69.1, SD = 11.2)\) performed significantly better than the older adults \((M = 49.3, SD = 12.4)\) on the DSS test, \(t(101) = 8.52, p < .001.\) The young adults \((M = 10.4, SD = 3.5)\) also performed significantly better than the older adults \((M = 7.4, SD = 2.7)\) on the Reverse Digit Span test, \(t(101) = 4.74, p < .001.\) Collectively, these patterns of results indicated that the samples were representative of their respective populations.

The benchmark data reported here were extracted from the work of Tversky and Kahneman (1988). These data represent the participation of hundreds of undergraduate students enrolled at Stanford University and the University of British Columbia during the 1970s. Therefore the variety of samples, different sampling methods, and large sample size make the benchmark data stable, as indicated by a standard error of 0.14. Thus the benchmark data are suitable for use as an estimate of the population. Given the medium effect size for framing phenomena \((\omega^2 = .05)\) reported by Kuhberger (1998) in his meta-analysis of 136 empirical investigations of framing, estimates for power exceed .80 with 58 participants in each of the current samples.

**Materials**

The framing task consisted of 16 decision scenarios adopted from stimuli described by Tversky and Kahneman (1988). For each scenario, participants made a risky choice by selecting one of two options with specified probabilities of occurrence. Decisions concerned participants’ well being in two different contexts: health and finance. (The task is available from the corresponding author.)

Comparison of the benchmark data with those of young and older adults required that the values associated with decision options be consistent. Choices associated with the health-related decision scenarios were not altered from their original format; however, the values associated with financial decisions changed over time as a function of the economy, and therefore the dollar values of the financial decision options were transformed to match the current rate of inflation. New dollar values based on yearly inflation rate change were determined by using an inflation calculator supplied by the federal government (Consumer Inflation Calculator, 1999).

In each scenario decision options were framed in one of three ways: positive, negative, and combination. For instance, positively framed decision options were described in terms of gains, whereas negatively framed options were described as losses relative to a
neutral reference outcome. Decision options that were described using both gain and loss terminology are products of combination framing.

Procedure

The demographic questionnaire, vocabulary, DSS, and Reverse Digit Span abilities tests were administered at the beginning of the experimental session. Participants were then given instructions for the framing task. Each experimental session lasted approximately 45 min.

RESULTS

Before examining potential age differences in framing, we compared benchmark data with data from the young adults to determine whether framing is subject to cohort effects. Second, we compared data from the older adults, who are from approximately the same generation as the participants sampled by Tversky and Kahneman (1988), with the benchmark data to further investigate how time of testing influenced susceptibility to framing. Finally, we compared the data from the young and older adults in order to determine how the effects of age and framing interact to influence decision-making behavior.

Current Young Adult versus Benchmark Data

Apparently differences in the effect of framing on decision making do exist between the benchmark data collected in the 1970s and the young adult data collected in 2001. The benchmark data represent the proportion of responses to each decision scenario that complied with the framing hypothesis such that positively framed decisions were risk averse and negatively framed decisions were risk taking. In an analogous fashion, the same proportions were calculated for the present young adult sample. Significant results from a $\chi^2$ goodness-of-fit test indicated that differences exist between the benchmark and the young adults, $\chi^2 (15) = 125.45, p < .01$. As the benchmark proportions are representative of the population being tested, we used them as the expected values in the $\chi^2$ goodness-of-fit test.

Although differences between the two young adult cohorts exist, the effects of framing on decision making appear to be relatively stable. The current young adults varied from the benchmark on a subset of financial scenarios. As shown in Table 1, the exact nature of the differences between the benchmark and the young adults.

### TABLE 1: Mean Proportion of Responses that Comply with the Framing Effect by Scenario and Sample

<table>
<thead>
<tr>
<th>Item</th>
<th>Scenario</th>
<th>Framing</th>
<th>Comparisons</th>
<th>Benchmark</th>
<th>Young Adults (2001)</th>
<th>Older Adults (2001)</th>
</tr>
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<tbody>
<tr>
<td>1A</td>
<td>Health</td>
<td>Positive</td>
<td>&amp;&amp;</td>
<td>82</td>
<td>66</td>
<td>62</td>
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<td>1B</td>
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<td>Negative</td>
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<td>56</td>
<td>38</td>
<td>45</td>
</tr>
<tr>
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<td>Finance</td>
<td>Positive</td>
<td>ns</td>
<td>84</td>
<td>83</td>
<td>83</td>
</tr>
<tr>
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<td>Negative</td>
<td>ns</td>
<td>87</td>
<td>76</td>
<td>81</td>
</tr>
<tr>
<td>3</td>
<td>Finance</td>
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<td>ns</td>
<td>72</td>
<td>69</td>
<td>81</td>
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<tr>
<td>4</td>
<td>Finance</td>
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<td>**</td>
<td>64</td>
<td>88</td>
<td>83</td>
</tr>
<tr>
<td>5A</td>
<td>Health</td>
<td>Positive</td>
<td>ns</td>
<td>72</td>
<td>76</td>
<td>79</td>
</tr>
<tr>
<td>5B</td>
<td>Health</td>
<td>Negative</td>
<td>ns</td>
<td>78</td>
<td>86</td>
<td>69</td>
</tr>
<tr>
<td>6</td>
<td>Finance</td>
<td>Combination</td>
<td>ns</td>
<td>100</td>
<td>97</td>
<td>89</td>
</tr>
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<td>Finance</td>
<td>Combination</td>
<td>**,&amp;&amp;</td>
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<td>73</td>
</tr>
<tr>
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<td>Positive</td>
<td>**++,+++</td>
<td>78</td>
<td>32</td>
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<tr>
<td>9</td>
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</tr>
<tr>
<td>10</td>
<td>Finance</td>
<td>Positive</td>
<td>**</td>
<td>74</td>
<td>37</td>
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<tr>
<td>11A</td>
<td>Health</td>
<td>Combination</td>
<td>ns</td>
<td>65</td>
<td>66</td>
<td>69</td>
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<tr>
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<tr>
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<td>Combination</td>
<td>ns</td>
<td>68</td>
<td>60</td>
<td>66</td>
</tr>
</tbody>
</table>

Note: Benchmark refers to Tversky & Kahneman, 1988; ns denotes that none of the comparisons was significant; ** denotes significant differences in comparison of benchmark and young adult sample; && denotes significant differences in comparison of benchmark and older adult sample; ++ denotes significant differences in comparison of present young and older adult samples.
adults was revealed by an item-by-item analysis that compared responses on each decision scenario. After we corrected for family-wise error through the use of a modified Bonferroni procedure, follow-up results from \( z \) tests revealed differences on five of the financial decision-making scenarios.

Of the scenarios for which cohort differences emerged, the options were negatively framed in one, positively framed in three, and framed in combination in one. Consistent with the framing hypothesis, the present cohort of young adults displayed an elevated level of risk taking because they were less willing than the past cohort to accept a sure loss of $200 in Item 4, which was negatively framed, \( z = 3.36, p < .001 \). With Items 8 and 10, which were positively framed and offered a “sure win” option, the present cohort was more willing to gamble to win extra money, rather than to choose the “sure win” option, than was the benchmark cohort, \( z = 5.56, p < .001 \), and \( z = 4.42, p < .001 \), respectively. On Items 7 and 9, in which a “sure win” option was not available, the present cohort was more likely than the past cohort to reduce chances of losing and optimize chances of winning money, \( z = 4.54, p < .001 \), and \( z = 3.86, p < .001 \), respectively.

Because cohort differences appeared in financial scenarios of all framing types, these results suggest that the present young adult cohort does not view finance decisions in the same fashion as did the 1970s young adults. The present cohort was more willing to gamble in both positive and negative framing situations, such that they aggressively tried to avoid losing money and pursued gaining extra money. Their willingness to accept financial losses to gain more money suggests that the financial context in which each cohort lived may have moderated the framing effect.

These analyses suggest that decision criteria concerning the value of life expectancy and health have remained stable but that those concerning money have changed during the last quarter century. The nature of these differences in financial decision making is unclear. Were differences between the current young adult sample and the benchmark data attributable to cohort effects or time-of-measurement effects?

To further explore this question, we compared the benchmark with a present sample of older adults. This analysis effectively isolated time-of-measurement from cohort effects. Consider the following: If the Tversky and Kahneman (1988) participants were retested in 2001, they would be close in age to the present sample of older adults; thus differences should clarify whether the framing effect on decision making is indeed subject to change over time.

**Current Older Adult versus Benchmark Data**

Differences emerged when data collected from the older adults were compared with the benchmark. However, differences were smaller than those we observed between the young adult sample and the benchmark. The proportion of older adults’ responses to each decision scenario that complied with the framing hypothesis was calculated. Significant results from a \( \chi^2 \) goodness-of-fit test indicated that differences exist between the benchmark and the older adults, \( \chi^2 (15) = 47.97, p < .01 \).

Following correction for family-wise error, item-by-item analyses revealed that these differences resulted from discrepant responding in two decision scenarios. One scenario was associated with financial decision making and the other with health-related decision making. On Item 7, in which a “sure win” option was unavailable because of combination framing, current older adults were more likely than the benchmark participants to reduce chances of losing and optimize chances of winning money, \( z = –3.90, p < .001 \). As Item 7 also evidenced differences between the young adult sample and the benchmark, these results support the notion that financial decision making in particular is susceptible to the influences of the financial context that pervades the time of testing.

By contrast, one health-related scenario did not replicate the framing hypothesis, and it was positively framed. In Item 1A, differences in risk aversion arose when older adults expressed a greater willingness to risk radiation therapy, \( z = 3.32, p < .001 \). Differences in health-related decision making may be attributable to knowledge of advances in medical science. After replication of the relative stability of decision making in the health-related context across time, these analyses suggest that the value of
life expectancy changed minimally during the last 25 to 30 years. Collectively, these findings suggest that cohort and time-of-measurement effects are important considerations when describing differences in susceptibility to framing. These results should qualify any age differences in framing.

**Current Young versus Current Older Adult Data**

Age differences in susceptibility to framing appear to be minimal. When proportions of participants who complied with the framing hypothesis were examined for each decision scenario, a $\chi^2$ test of independence revealed significant age differences in only one positively framed financial decision-making scenario. Results from Item 8, which offered a “sure win” option, suggest that young adults were more likely to gamble for more money instead of choosing the sure gain option than were older adults, $\chi^2(1) = -3.03, p < .01$. Because this same scenario can also be attributed to cohort effects, this minimal age effect in susceptibility to framing might disappear entirely once cohort differences are removed. These results strongly suggest that susceptibility to the framing effect is not an age-related phenomenon.

**DISCUSSION**

Comparisons of the decision-making behavior displayed by the benchmark participants and the current participants revealed several interesting findings. First, the effect of framing on decision behavior was relatively stable. The differences that did occur were mostly confined to financial decision making.

Second, susceptibility to the framing effect during decision making may be dependent on societal changes that influence how people value money and, to a lesser degree, on personal health. Most striking was the finding that differences were more numerous between cohorts than between time-of-testing or age groups. Clues to the nature of these differences in financial decision making may lie in the economic climate pervading the time of testing. For instance, the benchmark participants may have been less willing than the current samples of young and older adults to choose risky financial options because of the lack of monetary resources associated with the recession of the early 1970s. Thus changes in the susceptibility to framing attributable to cohort and time of testing may necessitate frequent evaluation and modification of instructional and educational materials designed to aid context-specific decision processes.

Third, the relative lack of age differences indicated that adults of all ages are susceptible to the framing effect. Thus susceptibility to framing effects is not an age-related phenomenon in that all people, regardless of age, can be manipulated with regard to accepting risk.

Although these findings are theoretically interesting, the limitations of the original work of Tversky and Kahneman (1988) and the present study should be noted. Because decision making, as measured here, was evaluated in the somewhat artificial environment of the laboratory, rather than in a more naturalistic setting, a number of criticisms apply. First, as the benchmark data and young adult data collected here represent the behavior of university undergraduates, the degree of generalizability of these results to the general population is uncertain. Nevertheless, as we investigated a more heterogeneous sample of older adults as well as young adults, our results should be more generalizable than those of studies that have investigated the behavior of undergraduate samples alone.

Second, the decision scenarios used here, though commonly used in the decision-making literature, may not be representative of all everyday decision problems. For instance, only two decision options were considered in each scenario, and each option had a specified probability of outcomes. However, given the variety of daily decision scenarios, our results should apply to a subset of everyday finance and health problems that are well defined and similar to the study scenarios used here.

Third, the decisions were hypothetical in nature because participants knew they would not experience the outcomes of their choices.

These criticisms are valid, but the utility of the present approach is clear. Obviously, there are ethical issues involved with manipulating decision frames for real financial and health decision scenarios. Thus the hypothetical scenarios used here seem appropriate, especially
considering recent evidence that differences in choices having real and hypothetical consequences are minimal (Wiseman & Levin, 1996).

Given these methodological limitations, the current results remain interesting because they uphold the relative strength and stability of the framing effect described by Tversky and Kahneman (1981, 1988) across all age groups. The finding that manipulations of decision frames can influence people’s perceptions of risky behavior has serious implications for a variety of everyday decision contexts, such as where to invest, what products to buy, when to comply with safety information, and which medical procedures to undergo. Inappropriate personal investment decisions and product purchases can be financially devastating. Likewise, poor decisions concerning compliance with product warnings and choices between medical procedures can be life threatening (Edwards, Elwyn, Covey, Matthews, & Pill, 2001; Zeitlin, 1994). Thus knowledge of how people of all ages can be manipulated to accept risk is crucial in understanding how people make decisions in their daily lives.

In summary, the robustness of the framing effect was apparent from the relative stability of decision-making data across cohorts, times of testing, and age. The data indicated that people of all ages are similarly affected by the framing effect and that apparent age differences in decision making might be better understood by examining cohort and time-of-testing effects that represent changes in the world surrounding the decision maker. By applying knowledge of framing susceptibility attributable to these complex interactions between cohort and time of testing to a variety of common decision contexts, future investigators of this important topic may influence the daily lives of adults of all ages.

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