EXAMINING THE INFLUENCES OF AN AUDIENCE AND INDIVIDUAL DIFFERENCES ON RISK-TAKING BEHAVIOR

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by
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Abstract

EXAMINING THE INFLUENCES OF AN AUDIENCE AND INDIVIDUAL DIFFERENCES ON RISK-TAKING BEHAVIOR

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The goal of this study was to examine how different types of people are affected by an audience on measures of risk-taking and expected value sensitivity (EVS; an individual’s ability to determine whether it is good or bad to take a risk). Participants completed individual difference measures of extraversion, neuroticism, and self-esteem, which were combined to create a continuous measure of orientation towards the social environment. To measure risk-taking and EVS, a new task was developed, the Appalachian Coins Task (ACT). Participants completed the ACT either in the presence of an audience or with no audience present. It was hypothesized that individuals would be more risky while in front of an audience. Additionally, it was hypothesized that the presence of an audience would have a stronger impact on risk-taking for negative-orientation individuals than for positive-orientation individuals. Finally, it was hypothesized that the presence of an audience would increase EVS for positive-orientation individuals and decrease it for negative-orientation individuals. While the results did not support these hypotheses, exploratory analyses revealed that the influence of an audience on people’s risk taking depended largely on
whether they had high or low self-esteem. Furthermore, more extraverted participants exhibited lower levels of risk taking, regardless of whether the audience was present or not. Taken together, these results highlight the importance of taking individual differences into account when studying the impact of an audience on risk-taking.

*Keywords:* Risk-taking, expected value sensitivity, audience effects, individual differences
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Dedication

This work is dedicated to all those who have made it possible for me to pursue my dream of a career in academia. In particular, I dedicate this thesis to my parents, Larry Smukler and Lisa Rule, and my grandparents, Frank and Jean Rule, for without their unfailing love and support through the years none of this would be possible. Thank you.
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Examining the Influences of an Audience and Individual Differences on Risk-Taking Behavior

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Abstract

The goal of this study was to examine how different types of people are affected by an audience on measures of risk-taking and expected value sensitivity (EVS; an individual’s ability to determine whether it is good or bad to take a risk). Participants completed individual difference measures of extraversion, neuroticism, and self-esteem, which were combined to create a continuous measure of orientation towards the social environment. To measure risk-taking and EVS, a new task was developed, the Appalachian Coins Task (ACT). Participants completed the ACT either in the presence of an audience or with no audience present. It was hypothesized that individuals would be more risky while in front of an audience. Additionally, it was hypothesized that the presence of an audience would have a stronger impact on risk-taking for negative-orientation individuals than for positive-orientation individuals. Finally, it was hypothesized that the presence of an audience would increase EVS for positive-orientation individuals and decrease it for negative-orientation individuals. While the results did not support these hypotheses, exploratory analyses revealed that the influence of an audience on people’s risk taking depended largely on whether they had high or low self-esteem. Furthermore, more extraverted participants exhibited lower levels of risk taking, regardless of whether the audience was present or not. Taken together, these results highlight the importance of taking individual differences into account when studying the impact of an audience on risk-taking.

Keywords: Risk-taking, expected value sensitivity, audience effects, individual differences
Introduction

Examining the Influences of an Audience and Individual Differences on Risk-Taking Behavior

Humans do strange things. Jumping out of a plane, gambling large portions of their earnings, engaging in unsafe sex, and taking drugs are all activities that people do for fun. These are activities that people participate in voluntarily, and they also carry a potential for loss. Humans often deliberately seek out activities that involve some level of danger—that is, they take risks.

Risk-taking behaviors are a prevalent aspect of the human condition; they exist across cultures and can manifest themselves in a variety of ways (Kim & Park, 2010). These behaviors are complex and can be influenced by individual differences, situational factors, and interactions between the two (Figner & Weber, 2011). Because risky behaviors often occur in the presence of other people—peers, friends, or family—one situational factor that seems particularly relevant to risk-taking is the presence or absence of others. While some studies have found that the presence of an audience can increase risk-taking (e.g., Gardner & Steinberg, 2005; Smith, Chein, & Steinberg, 2014), it seems plausible that being in the presence of other people might have a differential influence on people’s risk-taking depending on their personality characteristics.

Very few studies investigating audience effects have incorporated measures of individual differences, despite previous research suggesting that they may moderate the influence of an audience (Uziel, 2006). Additionally, the effects of a peer audience on
expected value sensitivity (EVS), a measure of good versus bad risk-taking, have not been examined. The goals of the present study were twofold. The first goal was to examine the influence of an audience and individual differences on risk-taking and EVS in a college-aged sample. In order to achieve the first goal, a new risk-taking task was needed. Therefore, the second goal was to develop a new task designed to measure both risk-taking and EVS within the same context.

**Background on Risk-Taking**

**Situational factors influencing risk-taking.** Although some amount of risk-taking is universal, there are a variety of factors that can influence the amount of risks one is willing to take. For example, it appears that individuals are not always risk-seeking or risk-avoidant—people’s risk-taking behavior depends on the domain of the risk being considered (Weber, Blais, & Betz, 2002). To examine people’s risk-taking in various real-world contexts, Weber et al. developed the Domain Specific Risk Taking Scale (DOSPERT). This self-report questionnaire measures attitudes towards risky behaviors in a variety of domains such as financial, health, recreational, ethical, and social. By dividing risk-taking into these domains, the researchers were able to measure differences in an individual’s risk-taking propensity across a variety of different real-world contexts. They found that while there are some consistencies, individuals often exhibit differences in their risk-taking behaviors and attitudes across different domains. For example, an individual who may be very likely to take risks in the financial domain may be averse to risk-taking in the social domain, or vice versa.

Another factor that influences risk-taking propensity is the way a question or situation is framed; a risk might be framed in terms of a gain or a loss. For example, in an oft-used
paradigm involving a disease scenario, given a sure option to save a small number people versus a chance to save everyone (but possibly lose everyone), people are generally risk-averse and choose the sure option of saving a smaller number of people (Tversky & Kahneman, 1981). In contrast, if the same question is posed as a sure chance of losing a small number of people versus a small chance of not losing anyone, people generally choose the risky option (i.e., try to save everyone, but possibly lose everyone). In short, people tend to exhibit a gain/loss bias by making more risky choices to avoid losses and fewer risky choices to achieve gains (e.g., Levin & Hart, 2003; Levin, Weller, Pederson, & Harshman, 2007; Tversky & Kahneman, 1981).

There are a variety of methods used to study the gain/loss bias. One measure that allows researchers to study this is the Cups Task (Levin & Hart, 2003). The Cups Task is a behavioral measure of risk-taking that consists of varying trials for gains and for losses. These trials are presented on a computer screen in the form of a split screen with two sides and cups on each side. For example, in a gains trial a participant would have the option of picking the “safe” side where each of five cups would have one quarter under it, or the “risky” side where one of the five cups has five quarters under it and the others have none. In a loss trial, picking the safe side would result in the sure loss of a small amount, and picking the risky side would result in a chance of losing nothing or losing a larger amount (see also, Levin et al., 2007). Using this behavioral measure of risk-taking, participants again exhibited the gain/loss bias. That is, they tended to be more risky in the loss trials than the gain trials.

**Individual differences and risk-taking.** In addition to the situational factors that can influence risk-taking, an individual’s characteristics (e.g., personality, age) also predict
his or her level of risk-taking. With regards to personality differences, numerous studies have found that neuroticism is related to risk-taking (e.g., Lauriola & Levin, 2001; Nicholson, Soane, Fenton-O’Creevy, & Willman, 2005). Neuroticism is typified by high levels of self-consciousness, anxiety, and emotional instability. Highly neurotic people tend to have low self-confidence, trouble coping with stressors, and feelings of vulnerability (Jeronimus, Riese, Sanderman, & Ormel, 2014). For these reasons, neurotic individuals tend to be more likely to experience feelings such as fear, frustration, and sadness.

Nicholson et al. (2005) examined how risk-taking across domains may differ based on personality. They found that neurotic individuals were less willing to take risks in all domains except for health. In the health domain, people with high neuroticism were more willing to take risks. Examples of health-related risks include smoking, high levels of alcohol consumption, and a poor diet. A possible explanation for this finding is that neurotic individuals are willing to take these risks because they serve as coping mechanisms and can alleviate their anxiety. In the other domains, they are less likely to engage in risky behaviors because those kinds of risks are more likely to introduce sources of anxiety.

While examining individual differences in the gain/loss bias, it was found that individuals with high neuroticism were less likely than low-neuroticism individuals to make risky decisions in the gains condition but more likely than low-neuroticism individuals to make risky decisions in the loss condition (Lauriola & Levin, 2001). In other words, high neuroticism is associated with an increased gain/loss bias. Lauriola and Levin suggested that this could be because neurotic individuals focus more on the possibility of a no-gains outcome in the gains condition and therefore avoid the risky option in order to take the more certain small gain rather than risk no gain at all. However, in the losses condition, neurotic
individuals focus more on the prospect of a sure loss, and thus take risks to avoid this possibility.

Another individual difference associated with risk-taking is one’s level of social anxiety—that is, anxiety caused by being in a social situation. Reynolds et al. (2013) examined the influence of social stress on risk-taking behavior in adolescents aged 15-18. In this experiment, researchers told participants that, after completing a decision making task, they would either have to give a speech in front of an audience (stressful condition) or that they could go home (non-stressful condition). Reynolds et al. found that high social anxiety adolescents exhibited greater risk-taking under the stressful condition than in the non-stressful condition. However, low social anxiety adolescents responded similarly in both the stressful and non-stressful conditions. In other words, the influence of being in a socially stressful situation differentially impacted people depending on their susceptibility to social stress. In a related study, Byrne, Silasi-Mansat, and Worthy (2015) found that neurotic individuals exhibited impaired decision making performance when they were placed under social or time pressure. However, their decision making performance was equivalent to less neurotic individuals when they were not under pressure.

One reason that neuroticism and anxiety are related to risk-taking could be due to the ambiguity involved in many risk decisions. When making risky decisions, people must weigh the potential benefits with the potential costs. If the likelihoods of the outcomes are clear, this may be relatively simple. However, in both real world situations and some lab tasks, these likelihoods are often ambiguous. Therefore, weighing the potential benefits and costs can become very challenging. Presumably, if a person is distracted, he or she would have a diminished ability to evaluate accurately the options and might instead resort to
heuristic processing (e.g., “A sure loss is bad,” “Winning something is better than winning nothing”; Chaiken, 1987; Petty & Cacioppo, 1986). Anything that limits cognitive resources devoted to the decision at hand is likely to increase people’s reliance on heuristic processing. When making a risky decision, people often experience some level of stress because of the cognitive effort required (Gathmann et al., 2014). Anxious and neurotic individuals are especially prone to having trouble coping with stressful situations (e.g., being asked to give a speech in front of an audience; Jeronimus et al., 2014; Reynolds et al., 2013), so when making a risky decision, these individuals may be experiencing a larger cognitive load than individuals who are not neurotic or anxious.

This explanation can account for the finding that anxious and neurotic individuals tend to have impaired performance on decision making tasks when under pressure (e.g., Byrne et al., 2015). Interestingly, this explanation can also account for the finding that highly neurotic individuals exhibit less risk-taking when risks are framed as gains but more risk-taking when risks are framed as a loss. As mentioned earlier, in a gain frame, neurotic individuals tend to focus on the prospect of not winning anything and avoid risky options (Lauriola & Levin, 2001). In other words, they appear to be guided by the mindset that a sure thing is better than the chance of not gaining anything. However, when in a loss frame, neurotic individuals tend to focus on the prospect of a sure loss and become risk-seeking. That is, they appear to be guided by the rule that sure losses should be avoided (Lauriola & Levin, 2001).

In addition to the personality characteristics associated with risk-taking, there are also a number of developmental factors related to one’s propensity to take risks. For example, one consistent finding in the literature is that adults (over 24) tend to take fewer risks than
adolescents (age 13-18) and college-aged individuals (18-24; Defoe, Dubas, Figer, & van Aken, 2014; Steinberg, 2007). Tymula et al. (2012) predicted that the high level of risk-taking in adolescents occurs because adolescents have an increased tolerance for ambiguous situations. To test their predictions, these researchers assessed preferences towards risk and found similar levels between adolescents and adults when risks were clearly stated. However, when the risk information was ambiguous, adolescents had a much more favorable view of risk-taking than adults. This finding may be important in the application of this research to real-world scenarios. Oftentimes, in the real world, there is inherent ambiguity involved in risky situations. For example a person deciding whether or not to invest in a company does not know the likelihood that the investment will pay off. Because these risky situations often involve ambiguity, it seems likely that adolescents will make more risky decisions than adults do in the real world.

Another explanation for the increased risk-taking among adolescents is that they have not yet developed the cognitive-control brain structures necessary to prevent or inhibit a risky response (Steinberg, 2007). Research suggests that these brain structures are highly involved in risky decision-making. Helfinstein et al. (2013) had participants complete a risk-taking task while inside an MRI machine. While completing this task, brain systems such as the insula, striatum, parietal cortices, and cingulate cortex (all involved in cognitive control and inhibition) were active when individuals were preparing to avoid a risk rather than engage in one. Based on these patterns, researchers were able to predict whether a participant would choose the risky or safe option in the task. These results suggest that in some contexts people’s default choice is the risky option; and in order to choose the safe response, people may need to exert cognitive energy to inhibit the risky response. For example, there are
some situations where people might make a number of increasingly risky decisions before deciding actively to change their course of action and play it safe (e.g., deciding how long to wait before applying the brakes at a red light or how many drinks is okay to consume before driving home). In these situations, the risky choice appears to be the default; and until executive processes are engaged to inhibit this choice, individuals will continue to take the risk. In support of the claim that individuals need to exert cognitive energy to inhibit risk-taking as their default decision, experiencing frustration, a factor that limits resources required for inhibition, has been shown to increase risk-taking (Ebbesen & Hanley, 1973).

It is worth noting that there are some situations in which adolescents do not take more risks than older adults. One factor that influences differences in risk-taking between adolescents and adults is whether they are engaging in logical or emotional risk-taking, or “Risk-as-Analysis” and “Risk-as-Feelings,” respectively (Slovic, Finucane, Peters, & MacGregor, 2004). Logical risk-taking involves careful deliberation of alternatives, while emotional risk-taking is based more on affective impulses. In any given risky situation, people are likely to use both logic and emotion; but in certain situations, one may overpower the other.

The Columbia Card Task (CCT) was designed to examine differences between logical and emotional risk-taking by isolating these components in two different versions of the task—the hot version (emotional) and the cold version (logical; Figner, Mackinlay, Wilkening, & Weber, 2009). In this task, participants are presented with a number of virtual cards on a computer screen that they can turn over to gain points. Most of the cards are gain cards, but some of the cards end the round (loss cards). In the hot version, participants turn over cards one-by-one until they hit a card that ends the round or they decide to stop picking
cards for that round. After each card is turned, a smiley face or a sad face is shown, indicating whether they gained points and may continue with the round or hit a loss card that ended the round. This version is considered emotional because of the affective response it creates through a combination of arousal produced by the uncertainty of turning each card over and the feedback after each card turn. These components are both lacking in the cold version. In the cold version, the participants select the number of cards that they want to turn over and then progress to the next round. In support of the claim that the hot version produces more arousal than the cold version, Figner et al. (2009) found that participants who went through the hot version reported higher levels of excitement and also had higher levels of electrodermal activity—a physiological measure of arousal. With regards to age-related differences in risk-taking, Figner et al. found that adolescents exhibited more risk-taking than adults only in the hot condition. This suggests that, in high-arousal situations, adults tend to be more risk-avoidant than adolescents. However, in low-arousal situations, adults and adolescents tend to exhibit a similar amount of risk-taking. This finding was corroborated by a recent meta-analysis that examined age-related differences in risk-taking across a variety of tasks (Defoe et al., 2014).

Not only are there age-related differences in risk-taking, but it seems that different age groups assess risky-decisions differently (Levin & Hart, 2003; Levin et al., 2007). In addition to examining such differences in overall risk-taking, Levin and colleagues examined whether children and adults differ in their ability to distinguish good risks from bad risks. To conduct this study the researchers used the Cups Task because it allowed them to measure both risk-taking and expected value sensitivity (EVS). The researchers defined EVS as a measure of how often a person makes the correct decision in a risky situation. A correct
decision is one in which the participant makes the choice that will, on average, yield the optimal outcome—i.e., the option with the higher expected value. For example, if John is offered a chance to buy a lottery ticket for $5 that has a 50% chance of winning $100 and a 50% chance of winning nothing, the optimal choice is to buy the ticket (rather than the safe option of saving $5 and not purchasing the ticket). On the other hand, if the $5 lottery ticket has a 50% chance of winning $7 and a 50% chance of winning nothing, the optimal choice for John would be to not purchase the ticket (rather than risking $5 for a 50% chance of winning $7). EVS is assessed in the Cups Task by creating trials where, on average, the participants will gain more money (lose less money) by picking the risky side (i.e., risk-advantageous trials), and trials where, on average, they will gain more (lose less) by picking the safe side (i.e., risk-disadvantageous trials).

Levin et al. (2007) had young children (age 5-7), older children (age 8-11), and adults (ages 18+) complete the Cups Task. With regards to risk-taking, they found that older children made more risky choices than adults, but younger children did not differ significantly from the older children or the adults. With regards to EVS, they found that EVS increased in a linear pattern as age increased. That is, young children had lower EVS than older children, and older children had lower EVS than adults. These findings suggest that as people get older, they are better able to discern the relative benefits and drawbacks of taking a risk. In other words, people appear to get better at distinguishing between good and bad risks as they get older.

**Audience Effects**

As mentioned earlier, a primary interest of this research is how risk-taking is influenced by the presence of other people. Before examining the research on risk-taking
and audience effects, it is important to understand how the presence of an audience influences behavior in a more general sense. A large body of literature dating back to the late 19th century has empirically examined audience effects and performance (Stroebe, 2012). In one of the first of these studies, it was observed that cyclists tended to perform faster when in the presence of another cyclist as opposed to when they were riding alone (Triplett, 1898). This effect was coined social facilitation. One of the first proposed theories behind social facilitation was Zajonc’s (1965) drive theory. This theory proposed that the mere presence of others increases an individual’s arousal, thus increasing his/her dominant response to the task—i.e., enhancement at easy tasks and impairment at difficult tasks. For example, Zajonc (1965) observed that when people were asked to perform a simple task such as following a target with a stylus in their hand, they performed better when there was an audience present than when they were alone. However, in a more difficult task such as memorizing nonsense syllables, participants did worse in the presence of an audience than when alone. Zajonc suggested that the audience need not be evaluating, judging, or co-acting with the participant—their mere presence alone was enough to cause the social facilitation effects. This mere presence increases arousal and therefore increases their dominant response (Platania & Moran, 2001).

Drive theory has received much empirical support (for a review, see Bond & Titus, 1983). Although the effects have been reliably supported, a number of issues have been brought up concerning this theory. One issue concerns the relative difficulty of the tasks being used in these experiments. While researchers have successfully manipulated simple versus complex tasks within experiments, there is not an operationalization of simple versus complex tasks across experiments. This means that one experiment’s simple task could be
another experiment’s complex task, making it difficult to attribute a causal explanation of performance level based on task complexity. Another issue is that, despite seeing social facilitation effects across many experiments, the effect sizes are consistently small (Bond & Titus, 1983; Uziel, 2006).

One of the reasons for the small effect sizes might be that the presence of an audience affects different people differently (Uziel, 2006). For example, regardless of task complexity, extraverts may perform better on a given task in front of an audience while introverts may perform poorly on a task when an audience is watching. In order to provide support for this idea, Uziel conducted a meta-analysis that examined the impact of individual differences on audience effects. To do this, he used the concept of a social orientation system, which is characterized as an individual’s stable positive or negative orientation towards his/her social environment. Individuals with a positive social orientation generally feel comfortable around others, enjoy the company of others, and react more positively to stressful social situations. On the other hand, individuals with a negative social orientation are generally more introverted (prefer to spend time by themselves), are often uncomfortable with social situations, and are less capable of handling stressful social environments. Thus, positive orientation corresponds with high extraversion, high self-esteem, and low neuroticism, while negative orientation corresponds with low extraversion, low self-esteem, and high neuroticism.

In his meta-analysis, Uziel (2006) found that, as compared to task complexity, a participant’s orientation towards social environment was a better predictor of how well the participant would perform in front of an audience. If a person was positively oriented, an audience generally enhanced his or her performance on a given task, whereas if a person was
negatively oriented, an audience tended to hinder his or her performance on a given task. Uziel concluded that task complexity might affect an audience’s influence on a target but that one’s social orientation plays a greater role in determining how one will perform when in front of an audience.

The notion that social orientation moderates the influence of an audience is important because very few studies have incorporated individual difference measures into research on audience effects. While there has been research on the influence of an audience on risk-taking (described in the following section), none of these studies have incorporated individual difference measures—a primary purpose of the present investigation.

**Risk-Taking and Audience Effects**

In real-world settings, people often make risky decisions in the presence of others. While most studies investigating audience effects evaluate how the presence of an audience affects a person’s performance on a task, some studies have investigated how an audience might influence risk-taking behavior. For example, Zajone (1970) conducted a study where participants made decisions about risky situations. In this risk-taking task, participants tried to earn as much money as possible. They were presented with a dichotomous decision to either play it safe (high probability for a low payout) or take a risk (low probability for a high payout). For example, in one decision, playing it safe corresponded with an 80% chance to earn ¾ of a cent and a 20% chance to earn nothing. Taking a risk corresponded with a 20% chance to earn three cents and an 80% chance to earn nothing. All participants completed a number of trials by themselves before they completed the remaining trials in one of the four conditions: by themselves, with another participant watching them, with another participant assisting them, or while another participant also completed the risk-taking task. In the three
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conditions where participants were in the presence of others, Zajonc found that participants exhibited an increase in their dominant response. Zajonc characterized the dominant response as the predominant response a participant gave when acting independently. In other words, participants who tended to avoid risk when responding alone became more risk-averse in the presence of others. Similarly, participants who tended to take a lot of risks when responding alone demonstrated higher levels of risk-taking while in the presence of others. This study suggests that drive theory holds not only in performance tasks, but in risk-based tasks as well.

To understand the research examining the presence of an audience on risk-taking, it is important to look at how audience effects may be moderated by age. As mentioned earlier, adolescents tend to take more risks than adults (Steinberg, 2007). Interestingly, the presence of peers seems to influence risk-taking in adolescents more so than in adults (Gardner & Steinberg, 2005). For example, Gardner and Steinberg conducted a study where participants completed a risk-taking task called “Chicken.” In the “Chicken” task, participants were seated in front of a computer where a virtual car moved across the screen. The participants made a decision about when to stop the car once a green traffic light turned yellow. Participants gained points by waiting as long as possible to stop the car. However, if they did not stop the car before the light turned red, then the car crashed and they were awarded no points. Risk-taking was operationalized as the amount of time an individual waited to stop the car. In this study, Gardner and Steinberg recruited samples of adolescents (age 13-16), young adults (age 18-22), and older adults (age 24 and older) who completed the risk-taking task either alone or in the presence of two same-age and same-gender peers who were also completing the task. Results indicated that, overall, risk-taking decreased as age-group
increased—a finding consistent with previous research on age-related differences in risk-taking (e.g., Levin et al., 2007). Additionally, when participants completed the task in a group, they exhibited more risk-taking than when participants completed the task alone. Perhaps most importantly, the increased risk-taking in front of an audience was most pronounced in adolescents, less so in young adults, and least in adults.

The increased influence of an audience for adolescents as compared to adults is observed even when negative outcomes of the risky behaviors are made explicitly clear. Smith, Chein, and Steinberg (2014) had adolescents complete a gambling task either alone or under the impression that they were being watched by a peer. Participants made more risky decisions when they thought they were being observed than when they were alone. These results held even when participants were given explicit information about the probability of winning and losing—that is, ambiguity was low. In contrast to overall risk-taking differences that seem to decrease as the ambiguity decreases (Tymula et al., 2012), the influence of an audience remained even in low-ambiguity situations. Participants continued to make more risky decisions in the audience condition even when negative outcomes with a high probability of occurring were clearly communicated to them.

A possible explanation for the increase in risk-taking while in front of an audience comes from the previously discussed fMRI study (Helfinstein et al., 2013). In this study, it was demonstrated that brain areas responsible for cognitive control and inhibition were active when participants chose the safe, rather than the risky option. That is, if cognitive resources are required to inhibit a risky decision, being in the presence of others could divert these resources away from the processes necessary to inhibit risky choice. This would lead to an increase in risky decisions while in the presence of others.
Relationships to real-world behaviors. A question that emerges is whether or not these lab-based risk-taking measures predict real-world risky behaviors. It turns out that many of these tasks have been demonstrated to do so. For example, one task that consistently correlates with real-world risky behaviors is the Balloon Analogue Risk Task (BART; Lejuez et al., 2002). In this task, participants are at a computer where they blow up a virtual balloon. As the balloon expands, more money gets added to the respondent’s “bank.” However, if they push the balloon too far it pops and they lose all their earnings for that round. At any point, participants can stop blowing up the balloon and bank their earnings. The more the participant tries to push his or her luck by blowing up the balloon, the higher their risk-taking score.

One study aimed to evaluate the BART by examining correlations between scores on the BART and self-reported risky behaviors (Lejuez et al., 2002). Researchers found significant positive correlations between risk-taking score and occurrences of more reality-based risky behaviors such as drinking, gambling, and unsafe sex. Additionally, they found significant positive correlations between BART scores and risk related constructs such as sensation seeking and impulsivity.

Many other studies also indicate that behavioral measures of risk-taking do correlate with risky behaviors such as cheating, unsafe sex, drug use, and gambling, among others (e.g., Aklin, Lejuez, Zvolensky, Kahler, & Gwadz, 2005; Lejuez et al., 2002; Zimerman, Shalvi, & Bereby-Meyer, 2014). Zimerman et al. tested whether measures of ethical risk-taking could be used to predict real-world dishonesty. These researchers measured ethical risk-taking through self-report and then presented participants with a task with an opportunity to be dishonest. In this task, being dishonest could increase the participant’s monetary
payoff. Results showed that high self-reported levels of ethical risk-taking correlated with high levels of actual dishonest behavior in the task.

**Present Study**

**Study rationale.** Risk-taking, individual differences, and audience effects are all important elements of human behavior that have been previously examined. However, to understand fully the influence of an audience on risk-taking, it is important to evaluate how often people take risks in addition to how often they take good risks and avoid bad risks—i.e., their sensitivity to expected value. This is important because the presence of an audience might differentially impact risk-taking and EVS. With regard to risk-taking, recall that research has demonstrated that the presence of others can cause people to make decisions consistent with their dominant or default response (Zajonc et al., 1970). Furthermore, it seems that in many situations the default response is to take a risk rather than play it safe (Helfinstein et al., 2013). In these situations people must exert cognitive resources to inhibit their dominant response and play it safe. If the presence of an audience is distracting (Baron, 1986) or limits cognitive resources in some way, it is likely that the presence of an audience will cause an increase in risk-taking. With regard to EVS, recall that in order to make a good decision, people must weigh the potential benefits with potential costs. If the presence of an audience is distracting, it is likely that the presence of an audience will decrease people’s ability to distinguish good risks from bad risks.

The above logic is based on the assumption that the presence of an audience is distracting (Baron, 1986). However, how people react in front of an audience is also influenced by their personality (Uziel, 2006). Specifically, individuals with a positive social orientation are comfortable around others and react more positively to being observed, while
individuals with a negative social orientation are uncomfortable with social situations and react negatively to being observed. Furthermore, anxious and neurotic individuals are less able to cope with situations they perceive as being stressful (Byrne et al., 2015; Reynolds et al., 2013). Therefore, individuals with a negative social orientation may be particularly influenced by the presence of an audience because their cognitive resources would be depleted by the anxiety produced by being observed by a stranger. While risk-taking, audience effects, and individual differences have been studied exhaustively, no research has examined whether the presence of an audience and an individual’s personality may interact to impact the way they make risky decisions. Given the conclusions that can be drawn from the literature, this seems like a particularly important research question worthy of a closer look. The primary goal of the present study was to fill this gap in the literature.

**Study overview and hypotheses.** The first goal of this study was to assess how audience effects and individual differences impact risk-taking and EVS. To do this, the presence of a peer audience was manipulated while participants completed a measure of risk-taking and EVS (described in detail below). Additionally, several personality measures were included to observe individual variation in social orientation. These included measures of extraversion, neuroticism, and self-esteem—the three components of social orientation (Uziel, 2006). Therefore, this study allowed for the examination of the influence of an audience on risk-taking and EVS. Furthermore, it tested whether these effects would be moderated by one’s social orientation. More specifically, the current study tested three hypotheses—the first two are specific to risk-taking while the third is specific to EVS.

**Hypothesis 1.** *On average, participants will exhibit more risk-taking in front of an audience than when no audience is present.*
Based on drive theory, an individual’s dominant response should increase in the presence of an audience (Zajonc et al., 1970). The presence of an audience may increase people’s dominant response by limiting their cognitive resources and making it more difficult for them to inhibit this response. Additionally, the literature suggests that risk-taking may more typically be people’s dominant response (Helfinstein et al., 2013). Therefore, a main effect where, on average, people will exhibit higher risk-taking in front of an audience than when no audience is present, was predicted.

_Hypothesis 2. The presence of an audience will have a larger effect on participants who have a negative social orientation as compared to those with a positive orientation._

The literature suggests that, when the risky option is the default option, cognitive resources are required to inhibit a risky response (Helfinstein et al., 2013). Individuals with a positive social orientation are generally comfortable and confident in the presence of others, while those with a negative social orientation are often uncomfortable around others and prone to stress and anxiety (Uziel, 2006). In other words, the presence of an audience should be more distracting for people with a negative orientation than a positive orientation. Therefore, people with a negative orientation should be affected to a greater extent than participants with a positive orientation.

_Hypothesis 3. The presence of an audience will increase EVS for positively oriented participants but decrease EVS for negatively oriented participants._

As described above, Uziel’s (2006) meta-analysis suggests that an audience will increase performance on a task for people with a positive social orientation but decrease performance for people with a negative social orientation. Since individuals with a positive orientation enjoy being around others, the audience will not distract them from their task and
may encourage them to put forth more effort (Muller & Butera, 2007). This will result in an increased ability to distinguish good from bad risks (i.e., higher EVS scores). On the other hand, because individuals with a negative orientation are uncomfortable in social situations, they will be distracted by the audience. This will make it more challenging for them to weigh the potential benefits and costs of risky decisions. Therefore, they will have lower EVS scores.

**Limitations of Established Risk-Tasking Measures.** In order to test the above hypotheses, it was necessary to use a measure that could assess both risk-taking and EVS. Despite the existence of many tasks that assess risk-taking, none were appropriate for the present study. For example, a number of risk-taking tasks (e.g., the BART, “Chicken,” the CCT) are valid measures of risk-taking but do not assess EVS. The Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994) is a risk-taking task that can assess participants’ ability to distinguish good from bad risks, but it confounds risk-taking with EVS. Specifically, the risky options are also those that have the worst payoffs. Therefore, it is not possible to evaluate whether a factor differentially affects risk-taking and EVS.

The only established measure that assesses risk-taking and EVS without confounding the two measures is the Cups Task (Levin & Hart, 2003). Unfortunately, it does so in a paradigm that does not represent many risky situations encountered in everyday life. In many real-world risky scenarios, individuals are presented with a scenario where playing it safe carries no consequence and taking a risk carries the possibility of a positive or negative outcome. In the Cups Task, participants are presented with a scenario where the safe option carries a guaranteed, albeit small, gain or loss, and the risky option carries the potential to either maximize a gain or minimize a loss (with the chance to gain nothing or lose a
significant amount). While this is a valid way to measure risk-taking, it does not adequately mimic the way risky decisions often occur in everyday life. Additionally, the Cups Task incorporates gain and loss trials, which was unnecessary for the purposes of this study.

Because of the limitations of the previous behavioral risk-taking measures, it was necessary to develop a new risk-taking measure. The measure that was developed was the Appalachian Coins Task (ACT). In the ACT (described in detail below), participants were presented with a risky or safe option. For the safe option, participants did not gain or lose anything. For the risky option, there was a chance that participants either gained something or lost something. The ACT has several advantages over similar tasks. Most importantly, it assess both risk-taking and EVS. Also, it has more applicability by presenting participants with a scenario that mimics many real-world risky situations. This task mimics real-world risky situations by presenting participants with a scenario where a risky choice may yield positive or negative outcomes and a safe option carries no consequences. For example when placing bets, one makes a decision between a safe option (not betting) and a risky option (betting, with the potential to win or lose money). Similarly, when deciding to go skydiving, one makes a decision between the safe option (do not go) and a risky option (go skydiving, with the potential to have a thrilling experience or to get severely injured).
Method

Participants

A total of 170 undergraduates at a Southeastern comprehensive university recruited through an online recruitment tool (the SONA System) participated in this study. Participants ranged in age from 17 to 39 ($M = 19.63$, $SD = 2.18$). Two participants did not report their age. The sample comprised 44 (25.9%) men, 125 (73.5%) women, and one individual who did not report his or her gender. Participants took part in this study as part of a course requirement and received a small amount of money ($3) as compensation.

This study was approved by the Institutional Review Board (IRB) at Appalachian State University (number 15-0081; approved on October 7th, 2014). A subsequent modification was approved on October 15th, 2014; see Appendices A and B for IRB approval notices. This study adhered to the ethical principles laid down by Appalachian State University.

Primary Measures

Risk-taking and EVS. The ACT is a behavioral measure of risk-taking and EVS that requires people to choose between a risky and a safe option (see Figure 1). The ACT is computer-based and presents participants with a screen depicting a safe option and a risky option. The participants see a variety of coins on the screen representing gains (green) and losses (red). The participants’ choice is either to play it safe (i.e., skip the round) or to make the risky choice (i.e., have the computer pick a coin at random). If they choose to pick a coin, there is a chance that they might lose points (if the computer randomly selected a red
coin) and a chance that they might gain points (if the computer randomly selected a green coin). The number of gain versus loss coins on the screen varies, as well as the number of points each gain or loss coin represents. Specifically, the number of gains coins (3, 4, or 5), the number of loss coins (3, 4, or 5), and points per coin (Gain +160, Loss -140; Gain +140, Loss -160; Gain +150 Loss -150) were manipulated. These three factors combine to create 27 different combinations. Twelve of these are risk-advantageous, 12 are risk-disadvantageous, and three have equal expected value.

In the ACT, the expected value is the average number of points the participant will gain/lose if they choose the risky side. If this expected value is above zero, this is considered a risk-advantageous trial. If the expected value is below zero, this is considered a risk-disadvantageous trial. For example, a trial with 3 green coins worth +160 points and 3 red coins worth -140 points has an expected value of +10 and is considered risk-advantageous. A different trial with 4 green coins worth +140 and 5 red coins worth -160 has an expected value of approximately -27 and is considered risk-disadvantageous.

EVS was operationalized by calculating the percentage of times a participant chose the risky side for the 12 risk-advantageous trials (positive expected value) or the safe side for the 12 risk-disadvantageous trials (negative expected value). Rounds where the expected value was zero were excluded from this calculation because neither the safe nor the risky option is better than the other. This measured the percentage of time that a participant was picking the “correct” option on the ACT, with higher percentages indicating higher EVS. Risk-taking was operationalized by calculating the percentage of the 30 rounds that a participant selected the risky, rather than the safe option (i.e., chose to pick a coin instead of to skip the round). Higher percentages indicate higher levels of risk-taking.
**Social orientation.** Social orientation was measured by combining three personality measures: extraversion, neuroticism and self-esteem. Extraversion and neuroticism were measured using their corresponding 10-item International Personality Item Pool (IPIP) Scales (Goldberg et al., 2006). Extraversion represents the extent to which someone enjoys being around others, has energy, and experiences positive affect. An example of an item is “I feel comfortable around people.” Neuroticism assesses negative affectivity, proneness to anxiety, and an inability to deal with problems. An example of an item is “I often feel blue,” or “I have frequent mood swings.” Neuroticism was reverse-scored so that its directionality in social orientation would correspond with that of extraversion and self-esteem. Reverse-scored neuroticism was conceptualized as a measure of emotional stability because low neuroticism scores correspond with stable affect and a more positive outlook. Self-esteem was assessed via the Personal Attributes Survey (Rosenberg, 1965). Self-esteem represents an individual’s subjective feelings of self-worth. An example of an item is “I feel comfortable with myself.”

Extraversion, neuroticism, and self-esteem were all measured by having the participants indicate how accurately each statement described them using a 1 (Very Inaccurate) to a 5 (Very Accurate) response scale. Previous research has demonstrated that these measures have acceptable internal consistency for extraversion (α = .86), neuroticism (α = .86), and self-esteem (α = .84; Goldberg et al., 2006; Rosenberg, 1965). In this sample, similar levels of reliability were found for extraversion (α = .87), neuroticism (α = .80), and self-esteem (α = .74). To create the measure of social orientation, participants’ responses were averaged across the three measures. This yielded a continuous measure of orientation towards social environment where high scores indicate positive orientation and low scores
indicate negative orientation. Internal consistency for the 30-item measure of social orientation was high ($\alpha = .89$).

**Exploratory measures**

**Numeracy.** Numeracy assesses an individual’s ability to work with and reason about numbers and mathematical principles. This was assessed using the Abbreviated Numeracy Scale (Weller et al., 2013), an 8-item questionnaire that requires participants to complete mathematical word problems without a calculator. Participants are asked open ended mathematical questions that range in difficulty. One example of an item is “A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?” An individual’s numeracy score is the total number of questions they answer correctly with higher numbers indicating higher levels of numeracy (in the current study, $\alpha = .50$).

**Fear of negative evaluation.** Fear of negative evaluation assesses the extent to which people are concerned with being evaluated unfavorably by others. Individuals with high fear of negative evaluation are more likely to behave in ways that will keep them away from situations where they may be perceived or evaluated negatively. This was assessed using the 12-item Fear of Negative Evaluation Scale (Leary, 1983). An example of an item is “I am frequently afraid of other people noticing my shortcomings.” Participants responded on a 1 (not at all characteristic of me) to 5 (extremely characteristic of me) response scale. This measure has demonstrated good internal consistency in both previous research (Leary, 1983; $\alpha = .90$) and the current sample ($\alpha = .89$).

**Self-monitoring.** Self-monitoring assesses the extent to which an individual is concerned with acting appropriately in a given social situation. High-self monitors will often modify their behavior to fit into the social environment in which they find themselves, while
low self-monitors are less concerned with changing their behavior to accommodate their social environment (Snyder, 1974). This was assessed using the 13-item Lennox and Wolfe Self-Monitoring Scale (Lennox & Wolfe, 1984). An example of an item is “In social situations, I have the ability to alter my behavior if I feel that something else is called for.” Participants responded on a 1 (certainly, always false) to 6 (certainly, always true) response scale. This measure has demonstrated good internal consistency in both previous research (Lennox & Wolfe, 1984; $\alpha = .88$) and the current sample ($\alpha = .76$). The self-monitoring scale comprises two subscales: ability to modify self-presentation (previous research $\alpha = .77$, current sample $\alpha = .75$) and sensitivity to the expressive behavior of others (previous research $\alpha = .83$, current sample $\alpha = .69$).

Design

This study had a manipulated independent variable, an individual difference predictor, and two dependent variables. The independent variable (the presence or absence of an audience) was manipulated between subjects. The predictor variable was the participants’ level of social orientation. The dependent variables were risk-taking and EVS as assessed by the ACT.

Procedure

Participants were tested in pairs. When they arrived to the lab, each pair was randomly assigned to either the audience or no audience condition. After reading the consent form, the participants started on one of the two phases of the study. One phase involved participants completing the ACT, and the other involved participants completing the individual difference measures. Within a session, one participant was assigned to start with the ACT while the other was assigned to start with the individual difference measures.
Counterbalancing the order of the phases ensured that, at any given time, only one participant was completing the ACT. This was important because the audience (described below) observed each participant as he or she went through the ACT. The participants were not observed while completing the individual difference measures.

Participants who were assigned to the audience condition completed the ACT while being watched by two research assistants (one woman, one man) who were approximately the same age as the participants. The research assistants held clipboards to heighten the participants’ feelings that they were being watched. The research assistants were seated in between the two participants with their chairs oriented towards the participant who was completing the ACT first. Once both participants finished their first phase (either the ACT or the individual difference measures), the research assistants reoriented their chairs to face the participant who was beginning the ACT and instructed the participants to start on the second phase. Participants who were assigned to the no audience condition completed the ACT and the individual difference measures with only one research assistant in the room, seated a short distance from and facing away from the participants.

Before starting on the ACT, the participants were given instructions about the task and told that their performance would determine the amount of money they could earn; in reality, all participants earned $3 regardless of their performance on the task. The participants went through four practice trails to ensure they understood their task. The participants then went through each of the 12 risk-advantageous and 12 risk-disadvantageous rounds once and through the three equal expected value trials twice, resulting in a total of 30 rounds. The order of the 30 rounds was randomized for each participant.
In the individual differences phase, participants first completed the social orientation measure. This consisted of the three 10-item measures of extraversion, self-esteem, and neuroticism combined into one test. The order in which these 30 items were presented was randomized for each participant. Upon completion of the social orientation measure, participants completed the measures of self-monitoring and fear of negative evaluation. To ensure that both phases took the same amount of time to complete, the measure of numeracy always came at the end of the study (i.e., after the participants completed both the ACT and individual difference measures). Doing this ensured that both participants completed their first phase in approximately the same amount of time—regardless of whether they started with the ACT or the individual difference measures. Upon completion of both phases and the numeracy measure, the participants were asked their age and gender, thanked for their time, compensated $3 for their participation, and exited the lab.
Results

Of the 170 students who participated in this study, three were dropped from the analyses because they picked the risky option on every single trial of the ACT. This indicated that they either misunderstood the task or were not paying attention to the manipulation of expected value presented during the task. An additional two participants were dropped because they did not provide responses to all of the measures.

Appalachian Coins Task (ACT)

The ACT was designed to assess risk-taking and EVS. To get a measure of risk-taking, the percentage of rounds (out of 30) that the participant picked the risky option was calculated. While this value could conceivably range from 0% (the participant picked the safe option on every round) to 100% (the participant picked the risky option on every trial), risk-taking scores actually ranged from 10-87% ($M = 58\%$, $SD = 15\%$). The internal consistency of the risk-taking measure was relatively high ($\alpha = .78$), indicating that participants tended to respond similarly across the 30 rounds.

To assess EVS, the percentage of rounds when the participant picked the option with the higher expected value was calculated. Recall that there were 12 rounds that were risk-advantageous (i.e., the expected value of the risky option was greater than zero), 12 rounds that were risk-disadvantageous (i.e., the expected value of the risky option was less than zero), and six rounds that the expected value of the risky option was zero. For each round that the expected value of the risky option was not zero, it was determined whether or not the participant picked the option with the higher expected value (i.e., the participant chose the
risky option in the risk-advantageous rounds and the safe option in the risk-disadvantageous rounds). The option with the higher expected value was considered the optimal option. EVS was then calculated by examining the percentage of rounds that the participant picked the optimal option. This value could range from 0% (i.e., the participant never picked the option with the higher expected value) to 100% (i.e., the participant always picked the option with the higher expected value). In the current study, EVS ranged from 29-100% ($M = 80\%, \, SD = 12\%$). The internal consistency of EVS across the 24 rounds was acceptable ($\alpha = .60$).

Taken together, the above analyses reveal that the ACT appears to be a relatively reliable measure of risk-taking and EVS.

**Relationships among Measured Variables**

Before testing the hypotheses, it is instructive to examine the relationships between measured variables. In order to do this, numerous bivariate correlations were examined to explore associations among the primary and exploratory measures (see Table 1). A number of the correlations are worth noting. Risk-taking and EVS were negatively correlated with one another. Specifically, participants who tended to pick the risky option more often tended to have lower EVS scores. A somewhat surprising finding was that extraversion was negatively correlated with risk-taking. Numeracy and EVS were positively correlated such that people with higher numeracy scores were more likely to pick the option with a higher expected value.

The three components of social orientation—extraversion, emotional stability (reverse coded neuroticism), and self-esteem—were all positively correlated with one another. This lends partial support for the idea that these three measures form a similar construct. Social orientation was negatively correlated with fear of negative evaluations and
positively correlated with self-monitoring. In other words, participants with a more positive social orientation were less fearful of being evaluated by others and were better able to monitor and modify their behavior based on social situations.

**Primary Analyses**

To examine Hypotheses 1 (increased risk-taking in front of an audience) and 2 (the impact of an audience will be moderated by social orientation), a regression analysis was conducted using audience condition, social orientation, and the audience X orientation interaction term as predictor variables, age, gender, and the counterbalance factor (ACT first versus individual differences measures first) as control variables, and risk-taking as the outcome variable. Again, risk-taking was the percentage of time that a participant chose the risky, rather than the safe option on the ACT. The variables for audience condition and social orientation were mean-centered before conducting the analysis. When considered together, the results of the regression indicated that this model significantly predicted risk-taking, $R^2 = .08$, $F(6, 158) = 2.35$, $p = .034$. Orientation, $b = -0.05$, $p = .044$, significantly predicted risky behavior, with higher orientation participants taking fewer risks than lower orientation participants. However, the audience condition, $b = -0.01$, $p = .793$ did not significantly predict risk-taking. This result does not support the hypothesis that the presence of an audience would increase risk-taking. Furthermore, there was no interaction between audience condition and social orientation, $b = 0.05$, $p = .277$. This result does not support the hypothesis that the impact of an audience on risk-taking would be moderated by social orientation. For a graphical representation of results with orientation dichotomized, see Figure 2. With regard to the control variables, gender significantly predicted participant’s risky behavior, $b = -0.08$, $p = .003$, with men ($M = 63\%, SD = 11\%$) taking more risks than...
women ($M = 56\%, SD = 15\%$). Age, $b = -0.01, p = .324$, and the counterbalance factor, $b = 0.002, p = .931$, did not significantly predict risk-taking.

To examine Hypothesis 3 (the impact of an audience on EVS would be moderated by social orientation), a multiple regression analysis was conducted using the audience condition, social orientation, and the audience X orientation interaction term as predictor variables, age, gender, and the counterbalance factor as control variables, and EVS as the outcome variable. Again, EVS was the percentage of times that the participants picked the option with the higher expected value. The variables for audience condition and social orientation were mean-centered before conducting the analysis. When considered together, the results of the regression indicate that these predictors did not significantly predict EVS, $R^2 = .05, F(6, 158) = 1.27, p = .276$. The audience condition, $b = 0.04, p = .060$, predicted EVS at a marginally non-significant level, with participants in the no audience condition ($M = 79\%, SD = 11\%$) having a slightly lower EVS than those in the audience condition ($M = 82\%, SD = 12\%$). Social orientation, $b = 0.02, p = .357$, did not significantly predict participants’ EVS. Additionally, there was no interaction between audience condition and social orientation, $b = 0.02, p = .611$. This result does not support the hypothesis that the impact of an audience on EVS will be moderated by social orientation. For a graphical representation of results, see Figure 3. With regard to the control variables, age, $b = 0.01, p = .273$, the counterbalance factor, $b = 0.03, p = .136$, and gender, $b = 0.01, p = .658$, did not significantly predict participants’ EVS.

**Exploratory Analyses**

To examine how the exploratory measures impacted risk-taking and EVS, a number of additional multiple regression analyses were conducted. Each analysis used a measured
variable (substituting each in turn for the previous orientation variable), audience condition, and the interaction term to predict either risk-taking or EVS, while controlling for age, gender, and the counterbalance factor. For a detailed record of statistics, see Table 2. Some notable findings from the exploratory analyses are discussed below.

In terms of predicting risk-taking, both extraversion and fear of negative evaluations significantly predicted risk-taking. Participants with higher extraversion took fewer risks than lower extraversion participants. Participants with higher fear of negative evaluation scores took more risks than participants with lower fear of negative evaluation scores. There was also a marginally non-significant interaction between the audience condition and self-esteem on risk-taking. Participants with lower self-esteem took fewer risks in the audience condition than in the no-audience condition, while participants with higher self-esteem took more risks in the audience condition than in the no-audience condition. With regard to EVS, in addition to the marginally non-significant effect of an audience, only numeracy significantly predicted EVS scores. High numeracy participants had higher EVS scores than low numeracy participants.
Discussion

The present study examined how risky behavior might change when people are observed by an audience rather than not being observed and how this change may depend on one’s orientation towards the social environment. While none of the hypotheses were supported, there were still a number of interesting findings. Additionally, the study tested a new risk-taking task that researchers can use when studying these—and other—constructs. Taken together, the results provide a strong basis for future research examining risk-taking, audience effects, and individual differences.

Primary Findings

Hypothesis 1. The first hypothesis of this study was that individuals would be more risky when they were being observed by others than when they were not. This hypothesis was based on numerous studies that have found that risk-taking tends to increase when in the presence of an audience (e.g., Albert, Chein, & Steinberg, 2013; Gardner & Steinberg, 2005; Smith et al., 2014; Zajonc et al., 1970). As described earlier, one explanation for the increase in risk taking when other people are present is that the presence of an audience increases people’s dominant response (Zajonc, 1965) and that in risk-based tasks the dominant response is generally to take the risk (Helfinstein et al., 2013). In the current study, this hypothesis was not supported; the presence or absence of an audience had no effect on the level of risk-taking that participants exhibited. This finding, of course, contradicts previous research which has shown that the presence of others impacts risk-taking.
One possible explanation for the finding that an audience did not influence risk taking is that the audience manipulation was not strong enough. Recall that in the audience condition, two research assistants observed the participant as they completed the ACT. However, there was no evaluative or interactive component to the research assistant’s behavior—they were simply passive observers. Perhaps if the audience had been interacting with the participant in some way, the effect would have been stronger. However, while it is possible that the audience manipulation was not strong enough, past research has found heightened risk-taking using a variety of audience manipulations. For example, Zajonc (1970) used a few different audience conditions where the audience either watched, assisted, or simultaneously completed the task with the participant. In a study by Gardner and Steinberg (2005), participants in the audience condition completed the risk-taking task in groups of three. In fact, Smith et al. (2014) found audience effects on risk-taking when participants were under the impression their performance was being watched, but no other people were in the room. In this study, participants completed a number of risk-tasks on a computer. Some participants were told that they would be observed by another research participant as they completed the tasks via a closed circuit computer-system, while others were not told that they would be observed. Even though there was never an actual audience present, the participants made more risky decisions when they were under the impression that they were being watched. This suggests that the manipulation in the present study was strong enough and that this explanation is not viable for the observed lack of audience effects on risk-taking.

Another reason the audience did not influence risk taking could have to do with the demographics of the current sample. Much of the past research examining how the presence
of others impacts risk-taking has done so with an adolescent sample (e.g., Smith et al., 2014). Additionally, when comparing the effects across age groups, it has been demonstrated that the presence of an audience has a larger impact on adolescents (ages 13-16) than on young adults (ages 18-22) and older adults (ages older than 23; Gardner & Steinberg, 2005). However, despite seeing a diminished effect in younger individuals, Gardner and Steinberg found that the presence of an audience still increased risk taking in their young adult sample—the sample that most closely matched the sample in the current study. This seems to suggest that, with a college-aged sample, an effect of the audience on risk-taking would be expected.

Finally, and perhaps most importantly, the current study was the first to examine the influence of an audience on risk taking as measured by the ACT. While there are many similarities between behavioral risk-taking measures, performance on one is not always correlated with performance on another (Bishara et al., 2009). The ACT was designed to provide unambiguous information regarding the likelihood of positive and negative outcomes. Some previous studies investigating the influence of an audience on risk-taking behavior have used tasks where the likelihood of the positive and negative outcomes were less clear. For example, Gardner and Steinberg (2005) used the “Chicken” task. In this task, participants had to determine how long to wait to stop a virtual car after they saw a traffic light turn from green to yellow. The longer they waited, the higher their risk-taking score. However, if they waited too long, the traffic light turned to red and the car crashed into a wall. This task differs from the ACT in that the participants were not given any information as to how long it took for the yellow light to turn to red. That is, there was no explicit information available that they could use to evaluate the risk. It is, therefore, possible that
the presence of an audience is more likely to increase risk taking when the likelihood of the outcomes are ambiguous.

While it is possible that ambiguity is required to see audience effects on risk-taking behavior, it is worth noting that Smith et al. (2014) used a risk-taking measure called the Probabilistic Gambling Task (PGT) that is conceptually quite similar to the ACT. In this task, participants played through many rounds where they could choose either to gamble or skip the round. The gambles held a possibility of gaining points, losing points, or having a neutral outcome (i.e., no gain or loss). For each round, the participants were shown a pie-chart that indicated the likelihood that the outcome of the gamble would gain points, lose points, or be neutral. The number of points gained or lost remained constant across all rounds. While there are some differences between the PGT and the ACT, the two tasks are similar in that the likelihood of the potential outcomes are relatively clear. The fact that Smith et al. found that an audience increased risk taking as measured by the PGT casts doubt on the explanation that ambiguity is necessary.

Another study that used unambiguous information was conducted by Zajonc (1970). In this study, the participants were presented with a dichotomous decision either to play it safe or to take a risk. For example, one round presented participants with the option of playing it safe and having an 80% chance of earning ¾ of a cent and a 20% chance to earn nothing, and a risky option of having a 20% chance of earning three cents and an 80% chance to earn nothing. Note that the likelihoods of the positive and negative outcomes are made explicitly clear. In summary, past research that has identified an effect of an audience on risky behavior used different tasks and paradigms than those used in the present study.
However, despite these differences, the ACT is conceptually similar to other tasks so it is unclear whether using the ACT can account for the lack of an audience effect.

**Hypothesis 2.** The second hypothesis was that the audience would have larger impact on people with a negative social orientation than a positive one. This was based on research demonstrating that it takes cognitive resources to inhibit making a risky choice (Helfinstein et al., 2013) and the assumption that an audience would present more of a cognitive load for people with negative social orientations as compared to those with positive social orientations—thereby reducing their ability to inhibit making a risky choice. While social orientation did have an effect on risk-taking (discussed in detail below), it did not interact with the presence of an audience.

One possible reason that social orientation did not moderate the relationship between an audience and risk taking could be because of the particular audience manipulation used in the current study. As mentioned above, perhaps an audience who was evaluating or interacting with the participants would have had a greater impact. Specifically, it is possible that an evaluative or interactive audience would have had a greater impact for participants with a negative social orientation as compared to a positive orientation.

Another possibility has to do with the fact that this study was the first to investigate how the effect of an audience may interact with personality on a novel dependent variable. Previous research has demonstrated the moderating effect of social orientation on measures of task performance (e.g., a ping-pong game or multiplication task; Uziel, 2006). However, this study examined the effect of an audience on risk-taking, rather than task performance. It is possible that social orientation moderates the influence of an audience on task performance but not on risk taking.
It is worth noting that this study was the first to operationalize social orientation. Uziel (2006) identified the concept but only tested it via a meta-analysis examining previous studies that assessed the components of social orientation (extraversion, neuroticism, and self-esteem) in isolation. The previous studies did not measure social orientation as a singular construct. Perhaps the idea of this conceptual variable as a singular entity is not appropriate and individual difference measures should be observed individually rather than as a composite.

**Hypothesis 3.** The third hypothesis was that participants with a positive orientation would have a higher EVS while in front of an audience, and that participants with a negative orientation would have a lower EVS while in front of an audience. This hypothesis was based on the similarity between EVS and task performance. Specifically, EVS is a measure of how well the participants were able to distinguish good risks from bad risks. Previous research has demonstrated that individuals with a positive orientation generally perform better in front of an audience, while those with a negative orientation generally perform worse (Uziel, 2006). Although the audience did have a small (albeit non-significant) influence on EVS, this influence was not moderated by participants’ social orientation. Similar to the explanations provided above, this could be due to the specific audience manipulation used or the measurement of social orientation.

**Secondary Findings**

While the hypotheses were not supported, there were a number of interesting results. There was a relationship between risk-taking and EVS, where participants who took more risks had lower EVS. For most people, risk-taking was the dominant response and the average participant was taking the risk on 58% of trials. To obtain a perfect EVS score,
participants would have needed to take a risk on every risk-advantageous trial, and play it safe on every risk-disadvantageous trial. This would have corresponded to taking the risk on approximately 50% of the trials (exactly 50%, excluding equal expected-value trials). Participants in this study who were taking fewer risks had a higher EVS because they were more often inhibiting the risky option and playing it safe when it was optimal to do so.

With regards to the measure of risk-taking, men tended to take more risks than women—a finding consistent with prior research (Byrnes, Miller, & Schafer, 1999). The replication of this well-established finding provides some evidence that the ACT was accurately measuring risk-taking. Another important finding was that more numerate participants had higher EVS scores. This demonstrates that participants who possess the ability to work with numbers are able to better evaluate the probabilities in the risk task and make the correct decision—a finding that also replicates previous research (e.g, Cokely, Galesic, Schulz, Ghazal, & Garcia-Retamero, 2012; Ghazal, Cokely, & Garcia-Retamero, 2014).

Additionally, there was a marginal effect of audience on EVS; participants exhibited higher EVS when they were in front of an audience as compared to when not being observed by an audience. This finding relates to previous research examining social facilitation effects in that the presence of others often increases task performance for relatively easy tasks (Zajonc, 1965). Given that participants chose the correct option an average of 80% of the time, the ACT could be considered a relatively easy task—one that is more likely to produce facilitation as a result of the presence of an audience.

The exploratory analyses also revealed that self-esteem may be an important factor in determining the influence of an audience on risk taking. Participants with low self-esteem
took fewer risks while in front of others than when they were by themselves. The presence or absence of an audience did not predict risk-taking for participants with high self-esteem. This may be due to the fact that people with low self-esteem experience heightened risk aversion (Johanson, 2000). One would expect that this risk aversion would be exacerbated by the presence of an audience, since self-esteem is negatively correlated with fear of negative evaluations. While picking the safe option has no potential for loss, picking the risky option has a potential for gain or loss. People with low self-esteem might be averse to picking the risky option while being watched because if it turns out negatively, they would have been observed making a choice that turned out poorly. On the other hand, selecting the safe option has no possibility of turning out poorly. While this seems plausible, the current study cannot address this specific explanation.

As was demonstrated in the exploratory analyses, another finding was that participants with a positive social orientation were less likely to take risks. This finding was primarily driven by the extraversion component of social orientation, with more extraverted participants taking fewer risks. Past research examining the relationship between extraversion and risk-taking has yielded mixed results. Some researchers have found a positive relationship between extraversion and risky behaviors (e.g., Lee, Ogunfowora, & Ashton, 2005; Nicholson et al., 2005), while others have found no relationship (e.g., Vollrath, Knoch, & Cassano, 1999; Weller & Tikir, 2011). However, no prior research has demonstrated a negative relationship between extraversion and risk-taking. One possible explanation is that the research examining how personality relates to risky behavior primarily measures risk-taking using self-report, while the present study used a behavioral measure.
While there should not be a fundamental difference between the two, it is a potential source of variation that could be examined in future studies.

A final secondary finding was that participants with higher fear of negative evaluation scores took more risks than participants with lower scores. Prior research has not examined the relationship between these two constructs, so it is difficult to know the exact nature of this finding. Considering that fear of negative evaluation and extraversion are correlated, it is possible that, similar to the relationship between social orientation and risk-taking, this relationship is also driven by extraversion.

Limitations and Future Directions

Although there were a number of interesting findings from this study, it does have a few limitations worth considering. Perhaps most importantly, this study used a novel risk-taking task. As such, the ACT has not been validated, so it is not known whether it accurately assessed the conceptual variables of interest—risk-taking and EVS. However, as described earlier, it is quite similar to a number of other risk-taking tasks. Also, the finding that men took more risks than women provides indirect evidence that the ACT is a valid measure.

Another possible limitation has to do with the homogeneity of the sample, which was almost entirely college-aged and Caucasian. Because the present sample is limited in its diversity, it is necessary to consider that the findings do not generalize to a broader population. This is especially important considering that audience effects on risk-taking behavior have been found to vary as a function of the participants’ age (Gardner & Steinberg, 2005). A possible future study could replicate the current study, but with an adolescent sample. A number of previous studies have examined the influence of an audience on
adolescent risk-taking (e.g., Gardner & Steinberg, 2005; Smith et al., 2014); however, none have incorporated individual differences. As was hypothesized for the current study, it is possible that the presence of an audience would impact some people (e.g., those with negative social orientations) more than other people (e.g., those with positive social orientations).

Additional avenues for future research could be, as mentioned earlier, to investigate systematically the variety of audience manipulations that have been used in previous research, including co-actors, peer audiences, and evaluative audiences (e.g., Gardner & Steinberg, 2005; Smith et al., 2014; Zajonc, 1970). It is not clear whether audience characteristics differentially affect risk taking. For example, a college-aged participant might want to appear like a risk-taker in front of a peer but might be more cautious in front of an older adult. Future studies could manipulate the type of audience—in addition to including a no-audience condition—to test whether different audiences differentially influence risk-taking behaviors.

Recall that this study found that participants with low self-esteem took fewer risks in the presence of audience, while participants with high self-esteem were unaffected by the presence or absence of an audience. The moderating effect of self-esteem is interesting and warrants further exploration. It seems possible that the reason that the participants with low self-esteem took fewer risks was because they experienced a heightened sense of loss-aversion while they were being watched by others. A follow-up study could test this explanation by assessing risk-aversion in high and low self-esteem individuals while they are either alone or in the presence of others.
This study also demonstrated that the ACT appears to be a reliable measure of risk-taking and EVS. In addition to validation studies, future research could use the ACT to test how various factors influence risk-taking and EVS. For example, numerous studies have demonstrated the people with higher anxiety tend to take fewer risks (e.g., Giorgetta et al., 2012; Maner et al., 2007). However, what is less clear is whether anxious individuals take better or worse risks. Some studies suggest that anxiety impairs risk-taking (e.g., Miu, Heilman, & Houser, 2008), whereas other research has found that anxiety improves risk-taking (e.g., Martina & Sabine, 2009). This discrepancy could be the result of some tasks confounding risk-taking with EVS. For example, with the Iowa Gambling Task, the risky options are also the options with the worse long-term outcomes (i.e., lower expected value). Therefore, factors that decrease risk-taking as measured by the IGT also increase EVS. The ACT does not suffer from this problem. Therefore, the ACT provides a valuable addition in terms of evaluating how factors might differentially affect risk taking and EVS.

In addition to using the ACT in its current form, it can be modified in a variety of ways to further explore risky decision-making. One change could be the inclusion of high-risk high-reward trials. For example, some trials could present participants with a number of green coins representing small gains and one red coin representing a relatively large loss. Conversely, some trials could present participants with a number of red coins representing small losses and one green coin representing a large gain. Another modification could be to include ambiguous trials. In the current version, the probabilities of each outcome and the payouts were known. The ACT could be modified to include trials where, for example, the precise number of red and green coins is unknown. For example, imagine a trial with 7 coins—1 green, 1 red, and 5 gray. The participant would be told that the gray coins could be
either gain or loss coins, but they would not find out the true color of the gray coin until after they make their choice. Trials like these would include ambiguity by having coins that represent unknown outcomes to participants. In short, the ACT is a flexible tool for studying risk-taking that researchers will be able to utilize in future investigations.

Conclusions

Even though results did not support the hypotheses, a new and potentially useful behavioral measure of risk taking was developed that can contribute to future research investigating risky decision-making. This study also highlights the importance of considering individual differences as they relate to risk-taking behavior. Perhaps most importantly, the finding that self-esteem moderated the influence of an audience indicates that situational factors may not influence all people in the same way. Finally, this study highlights that there are many factors that influence people’s decisions to take risk, and it is important to continue to examine the situational and personality factors that influence risky behaviors.
References


Appendix A

From: Dr. Stan Aeschleman, Institutional Review Board Chairperson
Date: 10/07/2014
RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)
Study #: 15-0081

Study Title: Making Decisions 2
Submission Type: Initial
Expedited Category: (7) Research on Group Characteristics or Behavior, or Surveys, Interviews, etc.
Approval Date: 10/07/2014
Expiration Date of Approval: 10/06/2015

The Institutional Review Board (IRB) approved this study for the period indicated above. The IRB found that the research procedures meet the expedited category cited above. IRB approval is limited to the activities described in the IRB approved materials, and extends to the performance of the described activities in the sites identified in the IRB application. In accordance with this approval, IRB findings and approval conditions for the conduct of this research are listed below.

Regulatory and other findings:

The IRB determined that this study involves minimal risk to participants.
Appendix B

From: Dr. Lisa Grizzard, Institutional Review Board Chairperson
Date: 10/15/2014
RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)
Study #: 15-0081

Study Title: Making Decisions 2
Submission Type: Modification
Expedited Category: (7) Research on Group Characteristics or Behavior, or Surveys, Interviews, etc.
Approval Date: 10/14/2014
Expiration Date of Approval: 10/06/2015

The Institutional Review Board (IRB) approved the modification for this study. The IRB found that the research procedures meet the expedited category cited above. IRB approval is limited to the activities described in the IRB approved materials, and extends to the performance of the described activities in the sites identified in the IRB application. In accordance with this approval, IRB findings and approval conditions for the conduct of this research are listed below.

Submission Description:

In order to better measure participants' numerical ability we have decided to include another measure of numeracy, the Abbreviated Numeracy Scale (See ANS.docx). Research suggests that this measure often correlates with risk-taking, one of our variables of interest. Adding this measure to our protocol will allow us to obtain an overall better look at participants' numerical ability and how this construct may relate to our variables of interest.
Table 1.

*Descriptive statistics and correlations among primary and exploratory measures.*

<table>
<thead>
<tr>
<th></th>
<th>M (SD)</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
<th>7.</th>
<th>8.</th>
<th>9.</th>
<th>10.</th>
<th>11.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Risk-Taking</td>
<td>58% (15%)</td>
<td>-.34**</td>
<td>-.17*</td>
<td>-.07</td>
<td>-.10</td>
<td>-.14</td>
<td>.14</td>
<td>-.02</td>
<td>.00</td>
<td>-.04</td>
<td>-.02</td>
</tr>
<tr>
<td>2. EVS</td>
<td>80% (12%)</td>
<td>.05</td>
<td>.02</td>
<td>.02</td>
<td>.04</td>
<td>-.03</td>
<td>-.01</td>
<td>.00</td>
<td>-.01</td>
<td>.18i*</td>
<td></td>
</tr>
<tr>
<td>3. Extraversion</td>
<td>3.58 (0.63)</td>
<td>-</td>
<td>.30***</td>
<td>.40**</td>
<td>.72***</td>
<td>-.39**</td>
<td>.40**</td>
<td>.38**</td>
<td>.28**</td>
<td>-.13</td>
<td></td>
</tr>
<tr>
<td>4. Stability</td>
<td>3.62 (0.61)</td>
<td>-</td>
<td>.72**</td>
<td>.83**</td>
<td>-.51**</td>
<td>.18*</td>
<td>.25**</td>
<td>.04</td>
<td>.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Self-Esteem</td>
<td>3.83 (0.51)</td>
<td>-</td>
<td>.86**</td>
<td>-.48**</td>
<td>.21**</td>
<td>.21**</td>
<td>.13</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Orientation</td>
<td>3.68 (0.47)</td>
<td>-</td>
<td>-.57**</td>
<td>.34**</td>
<td>.36**</td>
<td>.19*</td>
<td>-.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. FoNE</td>
<td>2.90 (0.71)</td>
<td>-</td>
<td>-.13</td>
<td>-.23**</td>
<td>.02</td>
<td>.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. SM Overall</td>
<td>4.35 (0.49)</td>
<td>-</td>
<td>.82**</td>
<td>.81i**</td>
<td>.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. SM Mod.</td>
<td>4.29 (0.66)</td>
<td>-</td>
<td>.32i**</td>
<td>-.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. SM Sens.</td>
<td>4.40 (0.56)</td>
<td>-</td>
<td>.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Numeracy</td>
<td>4.25 (1.49)</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Note: EVS = Expected Value Sensitivity; Orientation = Orientation Towards Social Environment; FoNE = Fear of Negative Evaluations; SM Overall = Overall Self-Monitoring; SM Mod. = Self-Monitoring (Ability to Modify Self-Presentation); SM Sens. = Self-Monitoring (Sensitivity to Expressive Behavior of Others).

* p < .05, ** p < .01

i Spuriously inflated part-whole correlations.
Table 2.

Results from regression analyses for exploratory measures.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Risk Taking</th>
<th>EVS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full model</td>
<td>Measure</td>
</tr>
<tr>
<td>Extraversion</td>
<td>$F = 2.21, R^2 = .08$</td>
<td>-0.05*</td>
</tr>
<tr>
<td>Emotional Stability</td>
<td>$F = 1.91, R^2 = .07$</td>
<td>-0.03</td>
</tr>
<tr>
<td>Self-Esteem</td>
<td>$F = 2.12, R^2 = .07$</td>
<td>-0.03</td>
</tr>
<tr>
<td>Social Orientation</td>
<td>$F = 2.35, R^2 = .08$</td>
<td>-0.05*</td>
</tr>
<tr>
<td>Numeracy</td>
<td>$F = 1.69, R^2 = .06$</td>
<td>-0.01</td>
</tr>
<tr>
<td>FoNE</td>
<td>$F = 1.97, R^2 = .07$</td>
<td>0.03*</td>
</tr>
<tr>
<td>Self-Monitoring</td>
<td>$F = 1.29, R^2 = .05$</td>
<td>-0.004</td>
</tr>
<tr>
<td>Self-Monitoring (Modify)</td>
<td>$F = 1.51, R^2 = .05$</td>
<td>0.0003</td>
</tr>
<tr>
<td>Self-Monitoring (Sensitivity)</td>
<td>$F = 1.35, R^2 = .05$</td>
<td>-0.007</td>
</tr>
</tbody>
</table>

Note: For all $F$ values $df = 6, 158$. Values for measure, audience and interaction are unstandardized coefficients ($b$). Audience coded as 0 = no audience, 1 = audience present. FoNE = Fear of Negative Evaluations. † $p < .10$, * $p < .05$
Figure 1. Depiction of a single trial of the Appalachian Coins Task.
Figure 2. Risk-taking for the audience-present and audience-absent conditions as a function of participants’ level of social orientation.
Figure 3. Expected value sensitivity for the audience-present and audience-absent conditions as a function of participants’ level of social orientation.
Shanon Martin Smukler Rule was born in Concord, New Hampshire, to Larry Smukler and Lisa Rule. He graduated from Concord High School in June 2008 and began undergraduate study the following autumn at Guilford College in Greensboro, North Carolina. He received his Bachelor of Arts in Psychology with minors in Philosophy and Communications in May 2012. In the fall of 2013, Shanon began study towards a Master of Arts degree in General Experimental Psychology at Appalachian State University. He was awarded the degree in August 2015. In the fall of 2015, Shanon will begin study at the University of Iowa, where he will pursue a doctorate degree in Social Psychology.