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Are you more economic than a first grader?: A mixed methods approach in a common pool resources experiment

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ABSTRACT

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A Mixed Methods Approach In A Common Pool Resources Experiment

Keywords: economic education, experimental economics, naïve theories, economic socialization

The purpose of this mixed methods study is to investigate the similarities and differences between children, lay adults, and economics experts in a common pool resources game, thereby providing initial insight into children's naïve economic theories. Quantitative data is drawn from participation in an artifactual field experiment adapted from Knapp & Murphy's (2010) common pool resource game. Qualitative data is drawn from semi-structured interviews. By incorporating mixed methods within the framework of a common pool resources game, I capture both behaviors during the game and insight into reasons for those behaviors. I use a binary logistic model to predict participants' choices to play the game vs. take an allocation of a resource. The sample, *N*=47, consists of three purposefully selected groups: children, novice adults (no advanced economics knowledge), and expert adults (graduate level economics knowledge). Consistent with the literature, males are more likely to play the game and females are more likely to take the allocation. While the literature is mixed with respect to how children behave when compared to novice adults, this study finds children are significantly more likely to play the game than novice adults and equally likely to play the game as expert adults. Qualitative data provides possible explanations for these findings. Findings have implications for economic education curriculum design and instruction.

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Are You More Economic Than a First Grader?: A Mixed Methods Approach

in a Common Pool Resource Experiment

Socio-constructivist learning theory acknowledges the roles of the learner and the learner's social context in constructing knowledge (Murphy, 2012). Children construct new knowledge based on what they already know, therefore instruction should begin with what children already know and believe. Children organize what they know and believe into theory-like systems called naïve theories and use these naïve theories to "explain, interpret and make predictions about the world" within specific domains (Wellman & Gelman, 1998). Their naïve theories, however, are often incomplete or inaccurate when extended to a broader context (Vosniadou, 2013).

Naïve theories about biology, physics, and mathematics are highly developed and researchers use this empirical evidence to design instruction that addresses naïve theories (Inagaki & Hatano, 2002; Vosniadou, 2013). Once researchers identify naïve theories, they can "design research-based curricula, based on students' learning progressions which can identify the areas of students' prior knowledge on which new scientific information can be built while at the same time highlighting the areas that need to be revised" (Vosniadou, 2013). While research about the curricular implications of naïve theories is common in mathematics and science education, it is not common in economics education (Aprea, 2015). The National Voluntary Content Standards in Economics (the Standards) represent "the most important and enduring ideas and concepts" of economics (Siegfried & Meszaros & 1998). While the authors assert the benchmarks for each standard are "presented in a sequential order at appropriate grade levels" they do not provide evidence from learning theory literature or child development literature to support their sequence or appropriateness (Siegfried & Meszaros, 1998). Benchmarks in the Standards represent a long run progression of learning to achieve content mastery; however, in order to affect learning, these benchmarks need to take into account students' naïve economic theories so that the benchmarks map a path that builds upon aspects of naïve theories that are consistent with expert theories and addresses inconsistencies in a way that fosters restructuring of the naïve theory.

Experimental economics provides a framework through which we can explore children's naïve economic theories. Gummerum, Hannoch and Keller (2008) suggest that experimental economics is a useful tool to investigate social development, and provide a review of the existing body of research that spans the fields of developmental psychology and experimental economics. They conclude that interdisciplinary research would benefit both fields by utilizing economic games to investigate behaviors and reasoning across ages, species, and cultures. Given that economic socialization is a developmental process, using experimental economics games to investigate children's economic behaviors as well as children's implicit theories about cause and effect is an appropriate extension of Gummerum, Hannoch and Keller's argument. This study will provide initial insight into questions about children's naïve economic theories through a mixed methods approach to experimental economics games.

Literature Review

This review of the literature begins with a description of six studies where experimental economics games were applied to investigations of children's behaviors. Many of these studies come from Developmental Psychology literature; as such, authors hypothesize about factors affecting children's development. These studies examine several behaviors in children including contingent pro-social behavior, free riding, equity preferences, and inequity aversion. Behaviors are investigated through variants of classic experimental economics games including the dictator game, ultimatum game, and a simplified public goods game. While payoff dominance in experiments with adults is achieved through incentivizing behaviors with money, payouts in these experiments with children include money, stickers, crackers, and candy. In order to accommodate children as young as three years, many games involve apparatus that allow children to communicate decisions nonverbally. In addition to collecting data on experimental outcomes, authors also collect qualitative and quantitative data they feel may influence development of behaviors of interest. This includes demographic factors like age, gender, and socioeconomic status (SES) as well as reactions during experiments such as laughter, time to make decisions, stated justifications for decisions, and moral emotions and reasoning.

In the first of these six studies, Blake and McAuliffe (2011) investigated the development of two types of inequity aversion using the dictator game. Participants were 178 pairs of children ages 4-8 years. Pairs were assigned the role of either decider or recipient; roles did not alternate across rounds. The decider chose whether to accept or reject distributions of candy between the partners. The distributions represented equality, advantageous inequality, and disadvantageous inequality. The authors found children increasingly rejected disadvantageous inequalities with age. Additionally, children rejected large advantageous inequalities by 8 years of age. The authors conclude the behavior of 8 year olds is consistent with the behavior observed in adults.

Blake and Rand (2010) investigated how currency value affected children's behavior in the dictator game. Participants were 288 children ages 36–83 months. The authors used stickers as the resource in the dictator game. In order to establish different "currency values" the authors initially presented each participant with 4 stickers. Participants selected their favorite sticker and their least favorite sticker. Then, participants played the dictator game twice with an anonymous partner: once with 10 of their favorite sticker, once with their least favorite sticker. The authors found the proportion of children who make donations increases with age, but that the amount of the donation is consistent across ages. Additionally, equity preference is greater when the participant is allocating the lower value resource than when they are allocating the higher value resource for all children. The authors conclude this study is able to distinguish pro-social behaviors from equality preferences.

Gummerum, Hanoch, Keller, Parsons, and Hummel (2010) hypothesized that offers in the dictator game would increase with age, would be positively associated with female gender, and that moral attributions and emotions would predict outcomes. Participants were 77 children ages 3-5 years. The dictator game was played with 10 stickers that children could allocate between themselves and an anonymous partner. The authors measured moral judgments and emotions using two stories followed by questions about how the protagonist in the story felt, whether the protagonists were good or bad, and how the participant would feel if they were the protagonist. The authors found moral emotions were a stronger predictor of behavior in the dictator game than age or gender.

Gummerum, Keller, Takezawa, and Mata (2008) examined several questions with respect to pro-social behavior in the dictator game. The authors combined the results from the dictator game with the results of a measure of fairness preferences (questionnaire) and social justifications (group discussion). Participants included 3^{rd}, 6^{th}, 8^{th}, and 11^{th} grade students who participated in single-gender groups for all parts of the experiment. Individuals divided Euro coins between themselves and an anonymous partner of the same gender. Groups of three participants also made a shared decision about allocation between the group members and three anonymous others. The amount they had to distribute was 20 coins, but the value of the coins was lower for the 3^{rd} graders. The authors claim this is commensurate with the average amount of pocket money for each age group. The authors cite several studies to support their use of money with the third grade participants, arguing that there are no developmental differences in how third grade students' value money. The authors found no difference in allocation based on development (age). They found individuals' fairness preferences influenced allocations in the dictator game. Finally, they found moral reasoning and perspective taking influenced group decisions in the dictator game.

House, Henrich, Sarnecka, and Silk (2013) investigated behavior in the pro-social game. They were interested in the development of contingent pro-social behavior and its relationship to gender.

The participants were 80 children ages 3-7.5 years. Participants were shown two options for how to divide washers, either 1,0 or 1,1 between a present partner. Participants alternated role of "actor" in 4 practice rounds and 10 treatment rounds. Participants were told washers would be exchanged for stickers. The author's find that child age, not gender, is the better predictor of contingent pro-social behavior. They conclude that reciprocity develops around 5.5 years.

Vogelsang, Jensen, Kirshner, Tennie, and Tomasello (2014) were interested if children would behave similarly to adults in a public goods game, initially contributing and decreasing contributions in subsequent rounds. Participants were 48 children ages 5-6 years. The game was played in groups of four and while children knew the other members of their group, decisions were made anonymously. However, given the nature of the game, participants could deduce who had contributed to the public good based on the total in the public resource pool. The authors used an apparatus that distributed gumballs to either a private bucket of each participant or the public bucket for the entire group. If the participant selected the private option, the apparatus released two gumballs into the participant's bucket. If the participant selected the public option, the apparatus released four gumballs into the public bucket. After all participants played, the gumballs were transferred to clear tubes so the quantities could be easily compared. The game was intentionally designed to be nonverbal. The authors found children initially contributed less than adults, but that children's round two contributions were similar to adults' round one contributions. They did not, therefore, see the steady decrease in contributions that they expected. Additionally, there was a significant gender effect. Males consistently behaved selfishly while females demonstrated contingent cooperation. These results conflict with previous results indicating children this young do not display free-riding behaviors.

The literature presented above demonstrates that a variety of experimental games and designs can be successfully implemented with children by adapting instructions, participation mechanisms, and payouts. Prior research has focused on variants of pubic goods games and dictator games, but not on how children behave in common-pool resource games. In this study, I adapt Knapp & Murphy's (2010) innovative common-pool resources experiment so that choices made by children as young as five years can be compared to choices made by adults. Additionally, prior studies attribute differences in behavior between children and lay adults to developmental factors, contending young children are less likely than older children to behave similarly to lay adults. This provides a second opportunity for my study to contribute to the literature. Prior studies have compared children's behaviors and preferences to those of adults without specialized training in economics. In this study I compare children's behaviors and preferences to those of adults with and without specialized training in economics. If we hope to understand the development of children's thinking from naïve thinking to expert thinking, it is valuable to compare the behaviors and motives of children with the behaviors and motives of experts (Webley, 2005).

Purpose

The purpose of this mixed methods study is to investigate the similarities and differences between children and economics experts in a common pool resources game with respect to observed behavior, stated explanations of motives and preferences, and beliefs about motives of other players. This study employs the *data transformation variant*[1] of the *convergent mixed methods design* and the *follow-up explanations variant*[2] of the *explanatory sequential design* (Creswell & Plano Clark, 2011). Qualitative and quantitative data was collected from the same sample at the same point in time. Quantitative data was drawn from participation in an artifactual field experiment (Harrison & List, 2004) adapted from Knapp & Murphy's (2010) common pool resource game. Qualitative data is drawn from

[1] In the data transformation variant of the convergent parallel design, qualitative and quantitative data are collected at the same time from the same sample; qualitative data is transformed so it can be included in the quantitative analysis. Usually this is achieved through closed response questions. In this study, for example, participants were asked whether they would prefer to play a game to see how many quarters they could win or take a guaranteed allocation of quarters.

[2] In the follow-up explanations variant of the explanatory sequential design, quantitative analysis is conducted first, and then qualitative data analysis is used to explain quantitative findings. Usually, the qualitative data is collected after the quantitative data has been analyzed; however, all data in this study was collected prior to data analysis.

semi-structured interviews. Data from two interview questions is quantitized using emergent codes, and merged with quantitative data. Data from five interview questions is coded using emergent codes and analyzed to further investigate between-group comparisons. Appendix A contains the pre- and post-experiment interview protocols. Incorporating the quantitized data enhanced the quantitative model by facilitating the addition of stated preferences as predictors. The complete model predicted the likelihood each participant would choose to compete for a resource or choose a guaranteed allocation of a resource. By comparing qualitative data between participant groups (child, novice adult, and expert adult), I further explore similarities and differences between the three groups. Specifically, this study addresses the following research questions: (1) What factors predict choosing to play a common pool resources game instead of taking a set allocation of resources? (2) How do children's choices and explanations compare to those of novice and expert adults?

Methods/Design

The experimental design of this study is based on Knapp and Murphy's (2010) field experiment investigating the effects of a voluntary individual quota in a competitive fishery. The authors designed an interactive experiment where participants simultaneously scoop beans from a bowl. The beans represent fish and the bowl represents a fishery. The treatments in the experiment simulate conditions in two types of fisheries: competitive and quota. The authors conclude that both skill and performance influence participants to select the quota. Specifically, participants with lower skill and poor past performance are more likely to choose the quota than to choose the competitive fishery.

Equation 1 presents the design of the current using mixed methods notation.

$$[\,QUAN\; +\; qual\,] \;\rightarrow\; QUAL \;=\; develop\; theory \tag{1}$$

Although the convergent design usually places equal emphasis on the quantitative and qualitative strands, the data transformation variant places unequal emphasis on the two strands. In this case, the qualitative data (pre and post experiment interviews) is quantitized, therefore placing more emphasis on the quantitative methods. Following the brackets, the arrow and uppercase qualitative strand represent that analysis of the qualitative data will be used to further explain results from the quantitative model (binary logistic regression predicting participant choice to play the game) to investigate naïve economic theories. The procedural diagram in Figure 1 provides a visual representation of the study design including the level of interaction, timing, points of interface, and mixing strategies outlined in the Purpose section. Additionally, a detailed description of the data collection and analysis is outlined in the Procedure section below.

Sample

The sample, N=47, represents three purposefully selected groups. Group one, Children, consists of n= 15 six to eight year old participants of mixed gender. Participants were recruited from an after-school program that serves a large public school district in the Mid-Atlantic region. Group two, Novice Adults, consists of n=16 undergraduate and graduate student participants of mixed gender. This group is restricted and does not include students who have taken more than two economics courses at the undergraduate level. This restriction is important to establish participants are not economics experts and have similar economic knowledge as expected in the average adult population. Group three, Expert Adults, consists of n=16 economics experts. Expert is defined as having a Ph.D in Economics, or related degree, or having successfully completed coursework in a graduate program in economics, or related degree. Both novice and expert groups were recruited from a large Mid-Atlantic research university. Table 1 provides descriptive statistics for the three groups.

Procedure

The procedure for this study is divided into three steps: the pre-experiment interview, the experiment, and the post-experiment interview. The steps are described below.

Pre-Experiment Interview. Each participant completed an individual interview. The semi-structured interview questions are included in Appendix A. The first question is designed to reveal a participant's equity preference by asking him or her if a resource should be equally divided (equality preference) or if each person should be allowed to compete to earn the resource (equity preference). Development literature indicates that preferences for equity and equality vary across development with distinct preferences for equity versus equality at different ages. The second question is designed to elicit the participant's preference for receiving a guaranteed allocation of resources or competing to earn resources. Responses to the choice question may reveal participants risk tolerance, belief in their own skill, or preference for competition. Responses might also reflect participants' equity or equality preference. The interviewer asked participants to explain their responses to both questions. I fully transcribed interview recordings.

Experimental Procedure. After the interview, participants played five rounds of a variation of Hungry Hungry Hippos. The sessions included four participants. The experiment administrator's script is attached as Appendix B. Participants heard the instructions simultaneously.

The administrator introduced the game and demonstrated how to play the game by placing twenty balls in the middle of the board and pressing the lever of one hippo to show how the balls go through the hippo's mouth and into the collection reservoir. The administrator then removed the balls from the reservoir, counted them aloud, and placed them in a collection cup. The administrator explained that each ball would be traded for one quarter[3] at the end of the game. The participants played one practice round and received one quarter for each ball in their collection cup at the end of the round. The administrator facilitated four more rounds, for a total of five rounds. The first five rounds represent the *skill treatment*. During the skill treatment participants all play the game to earn balls.

After the five skill treatment rounds, the administrator explained participants now have a choice at the beginning of each round: they can choose to take an allocation four balls and place them in their respective collection cups, or they can choose to play the game and see how many balls they can earn. If they chose to take the allocation, they could not play the game during that round. The administrator added five balls to the common pool for each participant who chose to play the game. Participants completed 5 rounds comprising the *choice treatment*. Participants marked their choice on a card by circling a picture of four balls or a picture of the Hungry Hungry Hippos game board. Participants made choices simultaneously and independently to ensure decisions were not affected by decisions of the other participants. After participants completed the choice treatment rounds, they completed the post-experiment interview.

Post-Experiment Interview. After the experiment, each participant completed a second individual interview. The semi-structured interview questions are included in Appendix A. The first question, also question two from the pre-experiment interview, is designed to elicit the participant's preference for receiving a guaranteed allocation of resources or competing to earn resources. The second question asks participants to explain why they chose to take the allocation or to play game during the experiment. The third question asks participants about their perceptions of the other players' motives. Research shows that children younger than four years have difficulty understanding other

[3] Children received one dime per marble instead of one quarter based on two criteria: (1) maintaining a one-to-one conversion ratio between marbles and coins and (2) ensuring age-appropriate, relevant total payouts. These criteria were developed based on prior experimental economics research with children (Gummerum, Keller, Takezawa, & Mata, 2008). In this paper, all payouts are expressed in terms of quarters for simplicity and clarity.

people's motives might differ from their own, but children should be able to assign motives to others independent of their own motives by six years of age (Gummerum, Hanoch, & Keller, 2008). These responses could indicate perceived degrees of the selfishness of others or they might indicate others' equality preference. I fully transcribed interview recordings.

Analysis

The analysis includes both qualitative and quantitative analysis. The qualitative analysis includes coding and quantitizing interviews for inclusion in the quantitative analysis. The quantitative analysis includes using binary logistic regression to predict the probability of choosing to play the game. Below, I describe the qualitative analysis followed by the quantitative analysis.

Qualitative Analysis

The qualitative analysis is divided into two phases. In Phase 1, I quantitized participants' stated preferences for equity and competing for resources. I included these quantitized variables as independent variables in the binary logistic model. In Phase 2, I used grounded coding to identify themes from participants' explanations about their own choices and their perceptions about the motivations of others. From these themes, I coded participants' responses to interview questions. I used these coded responses to further interpret findings from the binary logistic model.

Phase 1 qualitative analysis. I coded each participant as having a preference for *equity* or *equality*. Participants were coded as having an equity preference if they would allow four strangers to play a game as a way of allocating 20 quarters. Participants were coded as having an equality preference if they would divide the quarters up equally among four strangers as a way of allocating 20 quarters. I also coded each participant as having a preference for competing for resources or taking a guaranteed allocation of a resource. If participants indicated they would rather play a game to see how many quarters they could win, they were coded as having a preference to play the game. If participants indicated they would rather take a guaranteed allocation of quarters, they were coded as preferring the allocation. These variables, *equity preference* and *preference for playing* were added to as independent variables to the quantitative data set. One participant from the expert group and one participant from the novice group did not articulate answers to questions that could be coded. These two participants were dropped from the quantitative analysis.[4]

Phase 2 qualitative analysis. I used grounded coding to identify emergent themes in participants' responses from pre- and post-experiment interviews. From the pre-experiment interviews, I coded explanations for equity preference and preference for playing games. From the post-experiment interviews, I coded explanations for preference for playing games, explanation of their own behaviors during the game, and explanations of the perceived motives of others during the game. I identified seven themes across participant responses: preference for competition, preference for distribution based on merit, inequity aversion, risk awareness (both risk aversion and risk seeking), skill in playing the game, marginal value of payout, and utility of playing the game. Table 2 contains descriptions and a sample response to clarify how each code was applied to participant responses. I used coded responses from the Phase 2 qualitative analysis to explore results from the binary logistic model.

Quantitative Analysis

I estimated a binomial logistic regression to predict the probability participants chose to play the game during the choice treatment. I used the empirical model Equation 2 below:

$$logit(\pi) = \alpha + \boldsymbol{\beta}_k \mathbf{X}_{ik} + \boldsymbol{\varphi}_q \mathbf{W}_{\mathrm{iq}} + \boldsymbol{\delta}_j \mathbf{Z}_{\mathrm{ij}} + \mu_i \quad (2)$$

[4] When asked the equity versus equality question, one participant from the expert adult group stated he would allow the group of four to decide for themselves how to allocate the quarters. When prompted to respond to what he would choose, the participant declined to answer. When asked the play versus allocation question, one participant from the novice adult group stated he would play the game, and then during his explanation about why he would play the game changed his response to take the allocation. When prompted to clarify his choice the participant was unable to decide which he preferred.

Where π is the probability of selecting to play the game, $\mathbf{X}_{ik}$ is the vector of quantitative variables of interest, $\mathbf{W}_{iq}$ is vector of quantitized variables, and $\mathbf{Z}_{ij}$ is the vector of control variables. Table 3 contains a list of variables and descriptions.

The vector of quantitative variables of interest includes variables for group (child, expert adult, and novice adult), and lagged performance. Child was the omitted group in the analysis. I differentiate between novice adults and expert adults because although the literature in economic socialization compares children's theories and understandings to the understandings of an average adult, I am interested in whether being an expert in economics influences behavior and preferences in the experiment when compared to children and novice adults. Lagged performance and skill are included because Knapp and Murphy (2010) found that this variable increases the odds a participant would choose to play the game. The vector of quantitized variables includes *preference for playing* and *equity preference*. These variables are based on coded responses from pre-experiment interviews. The vector of control variables includes gender. Gender is included because some studies find differences in behaviors and preferences based on gender. I intended to include percentage of females in each group as Charness and Rustichin (2011) found females behaved differently in mixed gender groups than in same gender groups, however, small cell size prevented me from including this variable in the model. I also intended to include age, as development literature indicates there are age-based differences in preferences (Blake & McAuliffe, 2011; Blake & Rand, 2010; Gummerum, Hanoch & Keller, 2008; House, Henrich, Sarnecka & Silk, 2013), however age was highly multicollinear with group and was subsequently dropped. Variable means, standard deviations, and bivariate correlations are presented in Table 4.

Results

The results section is divided into two stages. In Stage 1, I used a binary logistic regression to estimate a model predicting participants' likelihood of choosing to play the game. In Stage 2, I looked at similarities and differences between groups with respect to explanations of their own behaviors as well as their perceptions of other players' motivations to further explain findings from Stage 1. Below, I present the results from Stage 1, the logistic model, then results from Stage 2, the qualitative investigation of between-group comparisons.

Quantitative results

I employed a binary logistic regression to assess which variables were associated with selecting "play the game" in the treatment rounds. Variables were entered simultaneously from all three vectors: quantitative, qualitative, and control. The model includes five choices for each participant (N = 45) for a total of 225 observations. The model correctly predicts 86.7% of the cases (*-2 Log Likelihood* = 139.778, N = 225).

Table 5 presents coefficients, Wald Statistics, degrees of freedom, p-values, and odds ratios for all variables included in the model. Beta coefficients for four predictors were significant: Novice Adult (B = -1.185, *Wald* = 4.383, p = .036), Preference for Playing (B = 2.565, *Wald* = 20.313, p < .001), Skill (B = .710, *Wald* = 7.708, p = .005), and Female (B = -1.525, *Wald* = 6.179, p = .013). Interpreting the odds ratios in Table 5, all else constant, novice adults are 69.4% less likely than children to choose "play the game". However, for a one-unit increase in player's skill, a player is twice as likely to choose "play the game". Additionally, participants with a stated preference for playing the game are 12 times more likely as those with a preference to take the allocation to choose "play the game". Finally, females are 78.2% less likely than males to choose "play the game." The remaining three variables were not statistically significant predictors of choice to play the game. Expert adults are neither more nor less likely to choose "play the game" than children. A preference for equity and lagged performance did not affect participants' likelihood of choosing "play the game".

Qualitative results

In the second stage of qualitative analysis I used grounded coding to identify themes in participant responses and classify motives of players as well as their perceived motives of others. This analysis provided further insight into the similarities and differences between the choices made by children, novice adults, and expert adults. The binary logistic model showed that while children are more likely to choose to play the game than novice adults, they are equally likely to choose to play the game as expert adults, all else constant. Figure 2 presents a three-dimensional analysis of participants' interviews coded for risk awareness, utility, and marginal value. The figure reports number of occurrences of each code by group. In explaining their own choices as well as their perceptions of the choices of other players, children and expert adults referenced utility of the game more often than novice adults mentioned utility of the game. Novice adults, on the other hand, mentioned risk more often as motivating their decisions and the decisions of other players. However, expert adults weren't identical to children. Expert adults frequently mentioned the low marginal value of their decisions, while children never mentioned the value of their decisions.

Discussion and Limitations

The purpose of this analysis was to (1) investigate factors that affect participants' choice to compete for resources in a common pool resource game and (2) examine how children's choices and motivations compare to those of novice and expert adults. Consistent with the literature, males were more likely to play the game and females were more likely to take the allocation (Knapp & Murphy, 2010; Leman, Ahmed & Ozarow, 2005). While research suggests that females are more likely to behave similarly to males when in single-gender groups, small sample size prevented me from including this variable in the logistic model. The literature is mixed with respect to how children behave when compared to adults with average economic understanding (novice adults); this study finds that children were significantly more likely to play the game than novice adults, but that children were not more likely to play the game than adults with expert-level economics knowledge. This is an interesting finding because previous studies have not compared children's behaviors to the behaviors of economics experts.

Exploration of qualitative interview data reveals additional similarities between how children and expert adults describe their motivations and perceived motivations of others. Both experts and children express that having fun playing the game was an important factor in their decisions and the decisions of others. For children, this represented a choice between having fun and being bored or left out, whereas expert adults described this as a trade off between fun and risk. Alternately, novice adults more frequently mentioned trade offs associated with the risk of playing the game. They were less likely to play the game than the experts and children, and perhaps this is because they were more sensitive to the risk of receiving fewer marbles than they could have received if they took the allocation. While some expert adults also recognized this risk, awareness of risk appears to be mediated by the low marginal value of each marble. Expert adults more frequently discussed the low value of the payout in each round and of each marble when describing why they chose to play the game than did the novice adults. This could be partially explained by the annual incomes of the participants in each group. While I did not collect data about the annual income of participants, the expert group included faculty earning full time salaries, and the novice group included undergraduate and graduate students who most likely have significantly less income. I believe this is only a partial explanation, however, because the expert group also included economics graduate students; these graduate students are not earning full time salaries, yet they still described the low marginal value as mediating their choice to accept risk and play the game.

Interestingly, no children mentioned the payout when explaining their choices or the motivations of others. This could be evidence that I did not achieve payoff dominance with the child group, a possible limitation of this study. While most studies with young participants use non-monetary payouts like stickers and candy (Blake & McAuliffe, 2011; Blake & Rand, 2010; Gummerum, Hanoch, Keller, Parsons & Hummel 2010; House, Henrich, Sarnecka & Silk, 2013; Vogelsang, Jensen, Kirshner, Tennie & Tomasello, 2014), I chose to use money as a payout for consistency across groups (Gummerum, Keller, Takezawa & Mata, 2008). In future studies, it may be beneficial to revise this strategy. Instead of handing children their money at the end of the experiment, I could allow children to either take the money or use their money immediately to purchase items from a small "store" containing goods like stickers and candy. This will not only allow for consistent payouts among groups, but also help children quantify the value of the payout in terms of items they value. Sonuga-Barke & Webley (1993) used a similar strategy in their experiments assessing children's savings behaviors.

A second limitation is the small proportion of participants who selected the allocation instead of playing the game. Participants only selected the allocation in 34 of 225 observations. This could be due to many reasons including the low value of the payout and the relative size of the guaranteed allocation. Multiple participants mentioned the low value of the payout in comparison to the utility of playing the game, thus indicating the risk of playing the game when compared to the benefit (both in payout and entertainment value) was low. Future iterations of this experiment could incorporate an allocation amount varied by round. This would facilitate identifying participants' willingness to play and an allocation amount whereby more participants would consider taking the allocation.

With respect to the relative size of the allocation, taking the allocation ensured a participant would receive four marbles; however, for each participant who chose to play the game, five marbles were added to the common pool. Therefore, taking the allocation was one marble less than an equal division of the marbles in the common pool if the participant chose to play. Some participants believed they could earn at least their "share" of the common pool, or five marbles, indicating the one-marble difference between the allocation and the common pool may have discouraged participants from choosing the allocation. Knapp and Murphy (2010) included a cost for playing their game to identify whether they could induce more efficient outcomes by offering a guaranteed allocation. Perhaps future experiments could impose a cost of one marble, for example, if participants choose to play the game. While increased efficiency was not my focus, a private cost is a realistic parameter in a common pool resources game.

A third limitation is the small sample size. The sample size, combined with the small number of observations where participants selected the allocation, limited findings with respect to gender and age. Future studies could incorporate larger overall samples and purposively selected groups by gender. By selecting single gender and mixed gender groups, we could further investigate the relationship between group composition and participants' behaviors. Finally, the age of participants in each sample limited the use of age as a control variable. As the mean age of the expert adult group was significantly different than the mean age of the novice adult group, age was highly multicollinear with group. Future studies could include selecting novice adults from a more representative sample of the adult population, instead of only students at a university.

Conclusion

This preliminary study is an important step toward understanding how children think compared to adults when making choices in a common pool resources game. Interpretability of results is limited by the following: the small proportion of observations where participants chose the allocation, the small sample size, and the differences in mean age of novice and expert adults.

In spite of these limitations, findings have implications for future research in children's naïve economic theories. While children in this experiment behaved similarly to economics experts, it is clear from qualitative analysis that their motivations and their perceived motivations of others differed from not only expert adults but also from novice adults. This preliminary evidence suggests children's naïve economic theories differ from expert theories, as well as from naïve theories held by novice adults. There is an opportunity for future research to investigate these naïve theories using a mixed methods approach to experimental economics games with children. With a deeper understanding, we can ensure benchmarks in economic education map a long run progression of learning consistent with the development of children's naïve economic theories.

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Appendix A

Interview Protocols

Pre-Experiment Interview Protocol

Interviews are conducted individually and will take approximately 2 minutes per participant.

Show participant a pile of 20 quarters.

1. Imagine there are four people you don't know. Should I divide this pile of quarters up equally so that each player gets 5 quarters or should I let the people play a game to see how many each person can win? If they play the game, some people might get more quarters than other people.
2. Why do you think I should divide it equally (or let people play a game)?
3. Ask participant: Would you rather have 4 quarters now or would you like to play a game with three other people to see how many of the quarters in this pile you could win? If you play the game, you might get more than 4 quarters, or you might get fewer than 4 quarters.
4. Why would you choose the 4 quarters (or the game)?

Post-Experiment Interview Protocol

Interviews are conducted individually and will take approximately 2 minutes per participant.

Show participant a pile of 20 quarters. Take 4 of the quarters out of the pile and put them in a separate pile.

1. Ask participant if they would rather have 4 quarters now or would you like to play a game to see how many of the quarters in this pile you could win? If you play the game, you might get more than 4 quarters, or you might get fewer than 4 quarters. You would be playing with three other people.
2. Why would you choose the 4 quarters (or the game)?
3. If the answer is different from before the experiment, ask participant why he/she changed his/her mind.
4. During the game you could choose to get 4 quarters, or play a game. What choice did you make? Why did you choose to play the game (or take the quarters)?
5. Why do you think the other players chose to play the game (or take the quarters)?
6. Before today have you ever played Hungry Hungry Hippos?
7. Collect demographic data: age, gender, education

Appendix B

Experiment Instructions

Since this game will be played with participants as young as 6 years old, the instructions will be read to all participants. Participants will not receive written instructions. The following is a script to be read by the experiment administrator.

The sessions will include 4 participants. Participants will hear the instructions simultaneously.

> "We are going to play a game called Hungry Hungry Hippos. We will start each game with 5 balls per person. This means that when 4 people are playing there will be 20 balls in the middle of the board. Each player will press the lever of his or her hippo to collect the balls. Let me show you how it works."

(Administrator places balls in the middle of the game board and presses the lever of one of the hippos to demonstrate that the balls go into the hippo's mouth and are collected in the reservoir. Administrator takes the balls out of the reservoir and counts them as he/she places them in the collection cup.)

> "When we are finished playing the game, I will give you one quarter for each ball in your tube. Let's all try playing now. When I say "go" you can start playing. You should keep playing until there are no more balls in the middle."

(Administrator places 20 balls in the middle of the board and says, "go". When all of the balls are gone from the middle the administrator continues with the instructions).

> "Each player has his or her own collection tube. Take your balls and place them in your collection cup. I will now give you one quarter for each ball in your collection cup."

(Administrator counts each participant's balls and gives each participant one quarter per ball).

> "Now we are going to play the game 4 times in a row. Each game will start with 20 balls in the middle. Each game will end when there are no balls left in the middle. At the end of each game you will take your balls and place them in your collection cup. After everyone has placed their balls in their collection cup, we will start the next game. Does anyone have any questions about how to play the game?"

(Administrator should answer participants' questions that pertain to playing the game. Once all questions have been answered, the administrator should begin the 4 rounds. Once all four rounds have been played, the administrator introduces the next treatment).

> "Now I am going to give you a choice. I can give you 4 balls and you can place them in your collection cup, or you can play the game and see how many balls you can win. If you choose the 4 balls you will not play during that game. Does anyone have questions about the choice you get

to make?"

(Administrator should answer all participant questions, then hand each participant a card with two pictures: a picture of four balls like the balls from the game, and a picture of the game board)

"You each have a card in front of you with two pictures on it: a picture of four balls and a picture of the game board. If you would like to have 4 balls now to place in your collection cup please circle the picture of the four balls. If you would like to play the game to see how many balls you can win circle the picture of the game board. You should only circle one of the two pictures. You should make your choice without looking at what anyone else chooses. Please don't show your choice to any of the other players. Once you have circled your choice, pleas hand your card to me."

(If participant selects 4 balls, Administrator should hand the participant 4 balls and direct the participant to place the balls in his/her collection cup. If the participant chooses to play the game, the administrator should place 5 balls in the middle of the board. Once the first game ends, repeat the choice process with each of the participants 4 more times. Once the fifth game has ended, the administrator should proceed with the payout.)

"That was the last round of Hungry Hungry Hippos that we will play today. Now that we are finished playing, I am going to give you one quarter for each of the balls in your collection cup."

(Administrator counts each participants balls and gives each participant one quarter per ball.)

"Thank you for playing Hungry Hungry Hippos with me today."

Table 1

Sample Descriptive Statistics

Group		Frequency	Mean	Min	Max	*SD*
Group 1: Children						
N = 15						
	gender	male = 60% (9)				
	age (in years)		6.8	5	8	1.05
Group 2: Novice Adults						
N = 16						
	gender	male = 18.75% (3)				
	age		21.7	18	33	4.05
Group 3: Expert Adults						
N = 16						
	gender	male = 37.5% (6)				
	age		39.35	23	76	18.6
Total Sample						
N = 47						
	gender	male = 38.2% (18)				
	age		25.57	5	76	17.24

Table 2

Description of Qualitative Codes from Phase 2 Qualitative Analysis

Code	Description	Sample Response
Competition	Describes self or others as competitive or motivated by competition.	"because I wanted to compete against Chris and Ollie." *(child, female, 7 yrs.)*
Merit-based Distribution	Expresses a preference for distributing resources based on effort or skill.	"so they can show you their abilities and whomever is the best player can get the largest result, the biggest return" *(expert, male, 25 yrs.)*
Inequity Aversion	Expresses aversion to some having more than others.	"if someone has ten, and somebody has five, someone has more and that wouldn't be fair" *(child, female, 6 yrs.)*
Risk Awareness	Describes self or others as aware of the risk involved in making choices (including risk seeking and risk aversion).	"she would rather not risk getting less than four, like it wasn't worth risking it" *(novice, male, 22 yrs.)*
Skill	Describes self or others as having ability to perform poorly or well when playing.	"apparently I'm pretty good at it" *(expert, male, 25 yrs.)*
Marginal Value	Uses low value of payout as explanation for choices.	"It's just quarters, it's not that much money." *(novice, female, 30 yrs.)*
Utility of Game	Describes self or others as choosing to play because of inherent value of playing a game.	"because it's fun playing games" *(child, female, 5 yrs.)*

Table 3

Description of Variables Included in Equation 2

Variable	Vector	Description
Child	Quantitative variables	1 = age 5 – 8 yrs 0 = not age 5 – 8 yrs
Novice Adult	Quantitative variables	1 = adult with no advanced economics degree 0 = adult with advanced economics degree, or aged 5-8 yrs
Expert Adult	Quantitative variables	1 = advanced economics degree 0 = no advanced economics degree
Skill Rank	Quantitative variables	player's rank based on her total number of marbles compared to other players' total number of marbles after first five rounds
Lagged Performance	Quantitative variables	number of marbles received in previous round
Preference for Playing	Quantitized variables	1 = prefer to play 0 = prefer to take allocation
Preference for Equity	Quantitized variables	1 = prefer equity 0 = prefer equality
Female	Control variables	1 = female 0 = male

Table 4

Means, Standard Deviations, and Bivariate Correlations for Criterion and Predictors

Variable	*M*	*SD*	1	2	3	4	5	6	7
Choose to play	.85	.36	-.193**	.131*	.380**	.148*	.036	.111	-.223**
1. Novice Adult	.34	.48		-.516**	-.048	.150*	-.052	-.070	.346**
2. Expert Adult	.34	.48			.215**	.119	-.094	.047	-.290**
3. Pref. for Play	.83	.38				.262**	-.248**	.072	-.287**
4. Pref. for Equity	.65	.48					-.224**	.044	-.056
5. Skill Rank	2.7	1.07						.215**	.243**
6. Lagged Perf.	4.82	1.86							.003
7. Female	.57	.50							

Note: *M* = mean, *SD* = standard deviation, *N* = 225.

* *p* = .05, ** *p* = .01.

Table 5

Logistic Regression Analysis Summary for Variables Predicting Choosing to Play

Variable	*B*	*Wald*	*df*	*p-value*	*Odds Ratio*
Novice Adult[1]	-1.185*	4.383	1	.036	.306
Expert Adult[1]	-0.435	.435	1	.510	.647
Skill Rank	0.710**	7.708	1	.005	2.033
Lagged Performance	0.119	.776	1	.378	1.127
Preference for Playing	2.565***	20.313	1	.001	13.005
Preference for Equity	0.683	2.062	1	.151	1.980
Female	-1.525*	6.179	1	.013	.218
Constant	-1.100	.997	1	.318	.333

Note: *-2 Log Likelihood* = 138.98, N = 225

* p = .05, ** p = .01, *** p = .001

[1] Omitted category is Child

Figure 1

Mixed Methods Procedural Diagram

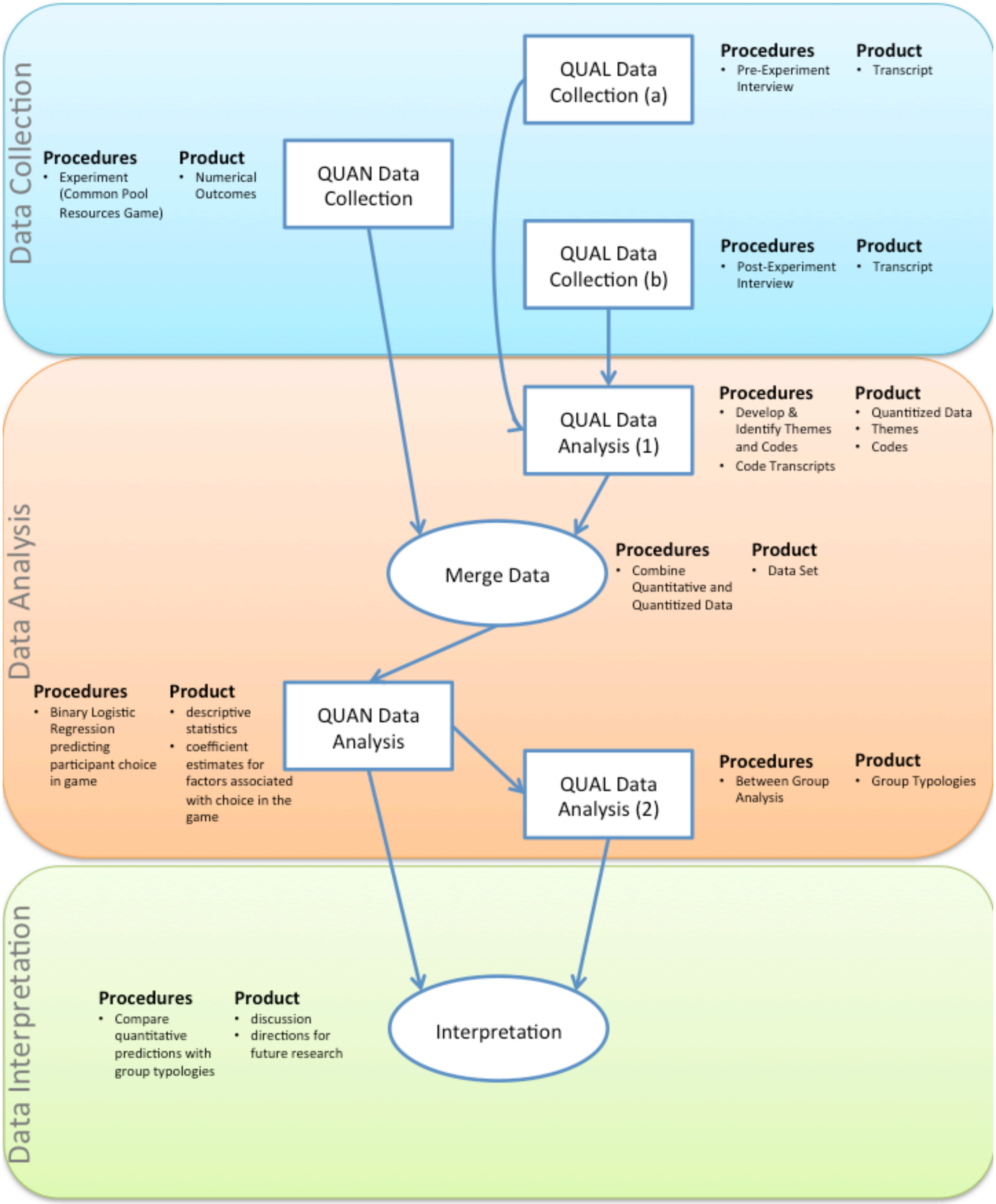
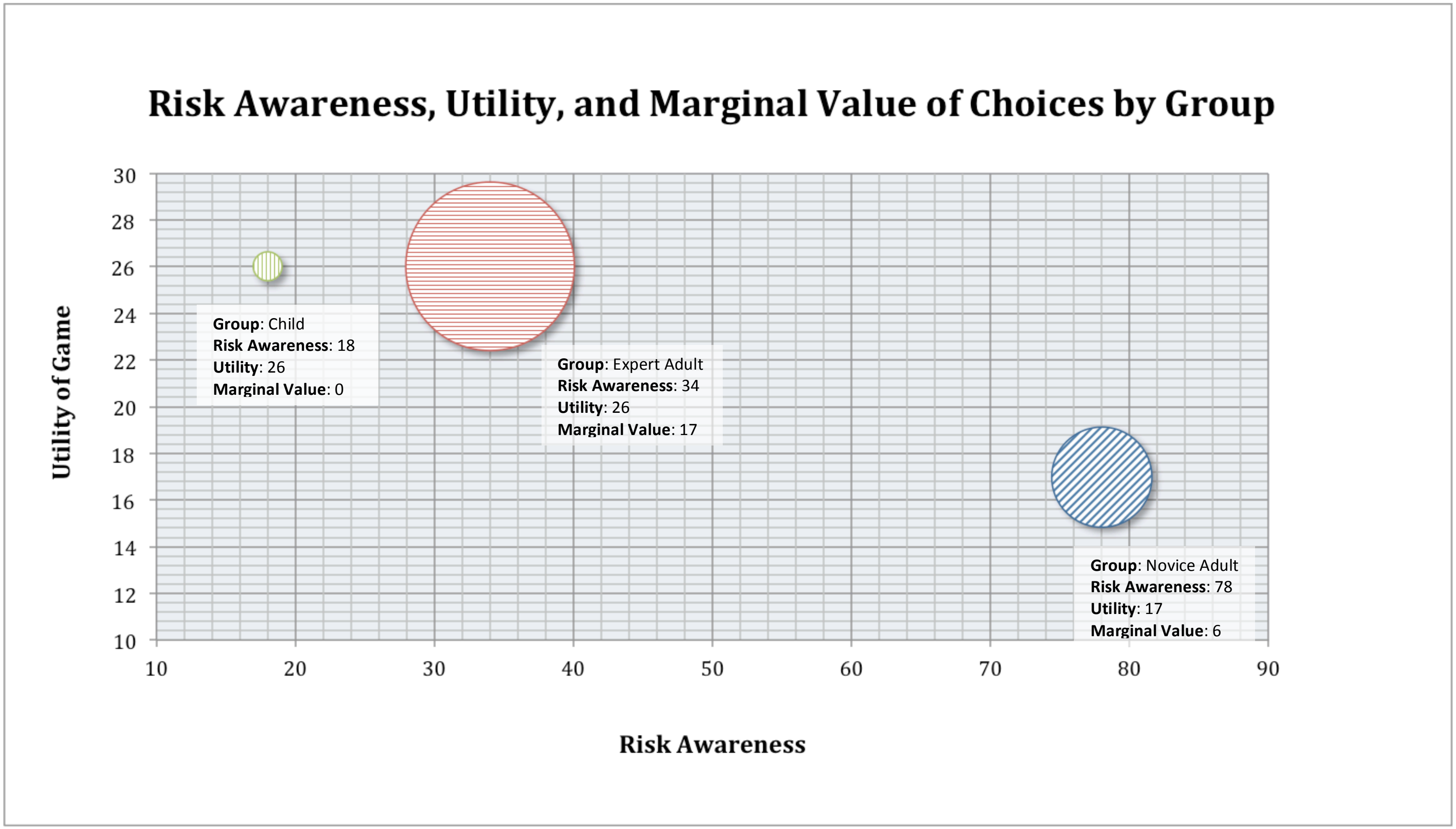


Figure 2

Risk Awareness, Utility, and Marginal Value of Choices by Group



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