Published in final edited form as:

J Exp Child Psychol. 2008 February ; 99(2): 114–134.

Age-related Changes in Children's Understanding Effort and Ability: Implications for Attribution Theory and Motivation

Amy S. Folmer, David A. Cole, Amanda B. Sigal^{*}, Lovisa D. Benbow^{*}, Lindsay F. Satterwhite^{*}, Katherine E. Swygert^{*}, and Jeffrey A. Ciesla
Vanderbilt University

Abstract

Building upon Nicholls' (1978) work, we examined developmental changes in children's understanding of effort and ability when faced with a negative outcome. In a sample of 166 children and adolescents (ages 5 to 15), younger children conflated the meaning of effort and ability, explaining that smart students work hard; whereas older children understood effort and ability to be reciprocally related constructs, explaining that smart students do not have to work as hard. Understanding the reciprocal relation between effort and ability was correlated with age. Age-related changes in the meaning and correlates of effort and ability were also examined. Developmental implications for attribution theory and achievement motivation are discussed.

Understanding Effort and Ability: Relation to Cognitive Development and Implications for Motivation

Children's understanding of effort and ability changes dramatically with age (Nicholls, 1978; Nicholls & Miller, 1984). For young children, ability and effort are positively related concepts; they believe that smart students are hard workers, and not-so-smart students do poorly because they do not work hard enough. For older children, ability and effort are reciprocally related concepts; they believe that smart students do not have to work hard, and conversely, that students who do have to work hard must not be so smart (Nicholls, 1979; Rholes, Blackwell, Jordan, & Walters, 1980; Fincham & Cain, 1986). Nicholls suggested that these age-related changes in the conception of effort and ability result from shifts in cognitive level of development. Examining the development of children's understanding of effort and ability is important not only in its own right but because effort/ability attributions are related to motivation and affect. The overarching goal of the current study is to extend Nicholls' work on the conceptualization of effort/ability and its relation to age and performance motivation.

Over 25 years ago, Nicholls launched a series of studies examining the development of children's understanding of, and differentiation between, ability and effort (Nicholls, 1978, 1979; Nicholls & Miller, 1983, 1984; Nicholls, Patashnick, & Mettetal, 1986). In one study, younger participants (5-9 years old) rated an actor exerting high effort as smarter than a low-effort actor who obtained the same score on a task. In contrast, older participants (10-13 years old) rated the low-effort actor as smarter (Nicholls, 1978). Younger participants failed to realize

Inquiries regarding this paper should be sent to David A. Cole in Psychology and Human Development at Vanderbilt University, Peabody MSC 512, 230 Appleton Place, Nashville, TN 37203-5701.

^{*}Order of authorship was determined randomly.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

that having to work harder to achieve the same score implies lower ability. Later, Nicholls and Miller (1984) included a Self condition in which participants themselves exerted high and low effort on a puzzle task. The results largely replicated Nicholls' earlier findings. Participants in the Self condition showed the expected developmental shift. Younger participants (second-graders and some fifth-graders) tended to rate the high-effort actor as smarter than themselves, whereas older participants (some fifth- and most eighth-graders) recognized that the actor who did not work as hard for the same outcome must have more ability. Personal involvement in the task did not systematically affect the developmental progression of children's understanding of effort and ability.

Based on these findings, Nicholls and Miller described four levels of development regarding children's differentiation of ability and effort (Nicholls, 1978; Nicholls & Miller, 1984). At Level 1 (5-6 years old), effort and ability are not differentiated and their relation to outcome is unclear. At Level 2 (7-9 years old), children attribute outcome purely to effort. At Level 3 (10-11 years old), children begin to distinguish between ability and effort and will inconsistently attribute outcome to one or the other. At Level 4 (12+ years old), the difference between effort and ability is clearly understood; ability is recognized as a factor that limits the effect of effort. The age ranges, although approximate and somewhat overlapping, suggest a clear developmental progression of effort/ability conceptualizations.

Understanding the relation of children's conceptualization of effort and ability to age is important, in part because of its relevance to children's causal attributions, motivation, and affect. Weiner (1985) described ability as the prototypic example of an internal, stable, and uncontrollable causal attribution, whereas effort exemplifies an internal, unstable, and controllable attribution. When so conceived, effort and ability attributions have very different implications for motivation and affect. Attributing negative events to internal, stable, uncontrollable causes (i.e., low ability) has been associated with increased personal threat and anxiety (Dweck & Leggett, 1988; Smiley & Dweck, 1994; Heyman & Dweck, 1998). When such attributions become chronic or style-like, motivation diminishes, negative affect increases, and problems associated with learned helplessness and depression can emerge (Abramson, Metalsky, & Alloy, 1989). Conversely, attributing negative events to internal but unstable and controllable causes (i.e., low effort) has been associated with the maintenance of motivation and shorter time to recovery from the effects of the negative events (Janoff-Bulman, 1979).

Weiner (1985) and Janoff-Bulman (1979) historically focused on the internality, stability, and controllability of an attribution, whereas Abramson et al. (1989) focused on less on controllability and more on globality. Because we believe that controllability and globality both constitute important dimensions of attributions, we examined both in conjunction with internality and stability. Therefore, although we may refer to only one or the other in the context of a particular measure or hypothesis, we consider effort to be an internal, unstable, specific, and controllable attribution, whereas ability is an internal, stable, global, and uncontrollable attribution.

The expectation that different outcomes flow from effort versus ability attributions relies upon the assumption that children understand ability as internal, stable, global, and uncontrollable, and that they understand effort as internal, unstable, specific, and controllable. Nicholls' work as well as work by a variety of others (Kun, 1977; Rholes et al., 1980; Marsh, Cairns, Relich, Barnes, & Debus, 1984) suggests that young children may not understand effort and ability in the same way adults do. Age-related limits on the capacity to understand the reciprocal relation between these dimensions may moderate the relation of ability and effort attributions to children's motivation and affect. If so, then researchers, educators, and clinicians interested in

the relation of children's effort and attributions to motivation and affect must take children's level of cognitive development into account.

The current study had three goals. The first was to replicate Nicholls' work and extend his line of investigation to situations involving negative outcomes. Children's effort/ability attributions for positive outcomes (as in Nicholls 1978, 1984) would not be expected to relate as strongly to motivational deficits or negative affect as would children's attributions about negative outcomes. In the current study, we examined children's understanding of effort and ability in the context of a task with relatively negative outcomes. Hypothesis 1 was that estimates of Nicholls' levels of effort/ability understanding would a) show a developmental progression and b) be similar to those he reported for events with positive outcomes.

Our second goal was to compare children's understanding of effort/ability in situations involving themselves to their understanding in situations that did not involve themselves. Nicholls replicated his findings under two such conditions (1978; Nicholls & Miller, 1984). In one condition, participants made effort/ability judgments about others. In the second condition, participants made effort/ability judgments about themselves relative to another person. In the current study, we used similar methods to compare Self versus Other conditions. Although developmental researchers have long noted that children tend to evince higher levels of cognitive functioning on self-relevant tasks compared to tasks involving hypothetical others (Piaget, 1932), we anticipated the opposite in this case. Self-serving biases have been shown to affect causal attributions about personal performances in relatively young children (Mezulis, Abramson, Hyde, & Hankin, 2004). Such effects should lead children to deny that a poor personal performance is due to low ability. A less mature understanding of the cause underlying a negative event would be more self-protective. Consequently, Hypothesis 2 was that children would apply less mature conceptualizations of effort/ability when the task involved their own poor performance.

Third, we reasoned that if children's understanding of effort and ability changes with age, then so should key correlates of these constructs. This premise generated three hypotheses. Hypothesis 3a was that the relation of effort and ability to each other would vary as a function of age. In particular, high effort followed by a poor outcome would have greater implications for low-ability inferences as children grow older. Hypothesis 3b was that higher effort coupled with a negative outcome would represent greater personal threat to older children and would therefore have stronger affective and motivational consequences for older than younger participants. Finally, Hypothesis 3c was that older participants would be more likely than younger participants to attribute a negative outcome following high effort to ability-related causes. In other words, in a high-effort condition, age would positively correlate with the tendency to attribute failure to internal, stable, and global causes.

Method

Participants

We recruited participants from two public elementary and one public middle school in a midsize southern city. We distributed consent forms to parents of 2nd, 4th, 6th, and 8th graders. Consent forms were returned by 200 parents, with 186 parents allowing their child to participate; 20 children were excluded because of language difficulties that would have interfered with their ability to complete the required tasks. The final sample included 166 participants (95% Caucasian, 2% Asian, 1% African-American, 2% other). See Table 1 for other demographics.

Overview of the Study

Figure 1 presents an overview of the measures and procedures. The study began with pretests of positive and negative affect, academic competence, and puzzle-solving competence. Then we randomly assigned individuals into either a low-effort ($n = 77$) or a high-effort ($n = 89$) condition, described below. Participation was divided into two parts. In Part I, participants engaged in a puzzle task, under either the high-effort or low-effort condition. After this, participants viewed one of the puzzle videos. Then all participants completed a manipulation check, followed by Question Set 1, which assessed (a) puzzle-related affect and motivation, (b) perceived effort and ability, and (c) attributions and controllability. In Part II, all participants viewed the 2-person math worksheet video (preselected to match the participant's age, sex, and ethnicity). After this, they completed Question Set 2, assessing (a) perceived effort and ability and (b) attributions and controllability.

Materials

Puzzle—For the puzzle task, we constructed an acrylic puzzle comprised of 13 transparent, irregularly-shaped, straight-edged pieces that fit within an $8'' \times 8''$ frame (see Figure 2). The puzzle was very difficult. Indeed, it was never solved (even by adults) in the allotted 2-minute time. Pilot research revealed that most attempts to solve the puzzle result in configurations in which all but one piece fit into the frame. This outcome creates an ambiguity as to how many pieces besides the last one were incorrectly placed. This ambiguity was ideal for our purposes, as it enabled us to provide false but plausible feedback to the participant as to how many pieces they had right.

Puzzle task (1-actor) videos—The first set of videos depicted a single child actor working on the puzzle task. In different versions of the video, we varied the actor's race, sex, and apparent grade level so as to match the participant's demographics. We also varied the degree of effort (high vs. low) exhibited by the actor. In the high-effort videos, the actor worked constantly for two minutes. In the low-effort videos, the actor was given alternating off-camera cues either to “work hard” or to “goof off.” (Participants could not hear these off-camera instructions because the videos had no volume.) Overall, the low-effort actors exhibited approximately 1 minute of high effort and 1 minute of low effort behavior over the course of the 2-minute video.

Math worksheet (2-actor) videos—The second set of stimulus videos depicted two actors sitting side-by-side, working on a sheet of math problems. In a given video, actors were matched to each other on race, sex, and grade level. Across videos, we varied the race, sex, and grade level of the actors so as to be able to match them to the participants' demographics. In each video, one actor exerted high effort and the other exerted low effort (as described for the 1-actor videos, above). We used $2.0'' \times 2.5''$ picture of the actors to assist participants while answering questions about the actors. All video clips were installed on laptop computers for presentation to participants in the schools.

Measures

Pretests—The first pretest measured positive and negative affect. We used 10 items from the Positive and Negative Affect Scale for Children (PANAS-C; Laurent et al., 1999). These represented the five most readable positive affect items (interested, excited, happy, energetic, cheerful) and the 5 most readable negative affect items (sad, upset, nervous, scared, afraid).¹

¹Readability was determined in a reading reaction time pilot study. PANAS words were presented on a computer screen to elementary school children, who read each word aloud into a microphone. Time between word presentation and the initiation of word pronunciation was recorded in tenths of milliseconds. The five PA words and the five NA words with the shortest reaction times in the pilot were used in the current study.

We read the words aloud as participants indicated how much they felt this way right now on 5-point scales (1 = not at all, 5 = extremely). The PANAS has excellent reliability and construct validity (Laurent et al., 1999). In the current study, Cronbach's alphas ranged from .89 to .92.

The second pretest was the Scholastic Competence subscale of the Self-Perceived Profile for Children (SPPC; Harter, 1985). For each of six items, interviewers read two statements (e.g., "Some kids feel they are just as smart as other kids their age. Other kids aren't so sure and wonder if they're as smart"). Participants select the statement that is most true for them and then indicate whether the selected statement is "sort of true" or "really true" for them. Items are scored on 4-point scales with high scores reflecting greater competence. The measure is valid and reliable (Muris, Meesters, & Figen, 2002). In the current study, the subscale had Cronbach's alphas ranging from .68 to .83.

Our third pretest assessed perceived puzzle-solving ability. We created four questions to assess participants' perception of their puzzle-related ability, motivation, speed, and preferences. As on the SPPC, participants selected one of two statements (e.g., "Some kids are really good at putting together puzzles like this. Other kids aren't very good at putting together this kind of puzzle") and then rated the selected statement as "sort of true" or "really true" about them. Items were converted to 4-point scales such that high scores reflect greater self-perceived competence. Cronbach's alpha for the scale was .87.

Question Set 1—Following the puzzle task, we assessed affect and motivation, effort-ability level, and attributions and controllability. For affect and motivation, participants started with a free response question, "How do you feel about getting 2 (or 3 or 4) out of 13 on the puzzle?" Then, they answered three closed questions: "Some kids feel sad after trying the puzzle; other kids don't feel sad" (sadness); "Some kids feel angry after trying the puzzle; other kids don't feel angry" (anger); "After they're done, some kids really want to work on the puzzle some more; other kids don't want to try the puzzle again" (motivation). After each selection, participants indicated how much their choice was "really like me" or "sort of like me." Answers to each of these questions were converted to 1 to 4 scales with 4s indicating higher levels of the construct.

To assess effort-ability level, we asked a series of questions based upon Nicholls' (1978) interview. The first two questions were "Who do you think is smarter, you or the child in the video?" and "Who do you think is better at puzzles?" Response options were 1 = He/she is a lot smarter/better, 2 = He/she is a little smarter/better, 3 = We're the same, 4 = I'm a little smarter/better, and 5 = I'm a lot smarter/better. As these items correlated .52 ($p < .001$), we averaged them together for data analysis. The next three questions had a free-response format: "How come both of you got the same score when you worked hard (or didn't work hard) and the actor didn't (or did) work hard? What would happen if you both worked really hard; would one of you do better than the other or would you do the same as each other? How can you tell?" Finally, the first two questions, assessing who was perceived as smarter and more able, were re-administered to assess any change in understanding after considering the free-response questions. Research assistants created a written verbatim record of all responses. Two independent raters scored the free-response questions using a rubric based upon Nicholls and Miller's (1984) descriptions of the four effort/ability differentiation levels. Because these questions built upon one another, the raters considered them together when making their judgments. Raters were naïve to the participants' ages, sex, and grade levels during the rating process. Raters were aware, however, of the participant's high- or low-effort condition, as this provided a context for their answers. Each participant's effort/ability question set was scored from 1 to 4, with 4 indicating the most mature understanding. Inter-rater reliability was good ($r = .87$). Disagreements were resolved by inter-rater conferences.

To assess participants' attributions for and controllability of the puzzle outcomes, we asked two sets of attribution questions. The first set was free response and assessed perceived stability and globality: "If I gave both of you a chance to do this puzzle again, would one of you do better on it or would you do the same as each other?" (stability); "What if I gave you both a different puzzle? Would one of you do better on it or would you do the same as each other?" (globality). "What if I gave you both a math worksheet to work on? Would one of you do better on it or would you do the same as each other?" (globality). Participants rated each on 5-point Likert scales, where 1 = "I'd do a lot better than him/her," 2 = "I'd do a little better than him/her," 3 = "We'd do the same," 4 = "He/she would do a little better than me," and 5 = "He/she would do a lot better than me." The second set of attribution questions was modeled after the Children's Attributional Style Interview (CASI; Conley, Haines, Hilt, & Metalsky, 2001). Participants provided the main reason that they got X puzzle pieces in the right place. Then they answered questions about this cause: "Is this because of you, or because of other people or other things?" (internality), "Will this reason be true just this time, or will it be true many other times?" (stability), "Will this just make you get a bad score on puzzles, or will it make other bad things happen in your life?" (globality), and "Is there anything you can do about this, or will it stay the same?" (controllability). Each was scored on a 4-point scale (with 4 reflecting more internality, stability, globality, or controllability).

Question Set 2—After the 2-person math worksheet video, we administered Question Set 2 to assess effort-ability level and causal attributions/perceived controllability. Our effort-ability level questions were similar to those used in Question Set 1, just reworded to reference two actors instead of one. For the closed questions, we revised the scoring so that a 1 indicated that the low-effort actor was seen as smarter/having more ability, and a 5 indicated that the high-effort actor was smarter/had more ability. We used the previously described rubric to score participants' answers to the open-ended questions. Inter-rater reliability was .88.

To assess stability and globality, we repeated the Question Set 1 queries, reworded to reference the two videotaped actors' outcomes. First, participants answered the three closed questions: e.g., "If Luke [the name we gave the low-effort actor] and Harry [the high-effort actor] both did the worksheet again, would one of them do better than the other or would they do the same as each other?" We scored responses so that 1 = the low-effort actor would do a lot better than high-effort actor and 5 = the high-effort actor would do a lot better than the low-effort actor.

To assess causal attributions and perceived controllability, the next set of questions was administered twice, once referring to the low-effort actor and once referring to the high-effort actor. These questions consisted of the CASI-like items (described above) inquiring about internality, stability, and globality of the main reason for the actor's outcome on the math worksheet. Finally, they provided information about perceived controllability either by naming some action the actor could take to prevent similar outcomes in the future or by saying there is nothing the actor could do. As before, high scores indicated greater internality, stability, globality, and controllability.

Procedures

Parental consents and child assents were obtained for all participants. Research assistants conducted all data collection at school during 40-minute, one-on-one sessions in a private room at the child's school. All items were read aloud to all participants, regardless of their age. Participants were told before the session started that they would receive a small gift such as a decorative pencil or a piece of candy at the end of the study, regardless of their performance on the tasks. Additionally, participants' parents had the option of accepting a \$15 payment or donating that money to the school for the purchase of educational materials.

Part I—We began the session by talking with the participant to reduce anxiety and build rapport. Prior to randomization, we administered the pretest measures of affect and self-perceived academic competence, and self-perceived puzzle competence. Then we began the Puzzle Task. A research assistant introduced the acrylic puzzle and initiated either the high-effort or low-effort protocol (determined by random assignment). For participants in the low-effort condition, instructions were as follows: “Think of a time when you didn't feel like working very hard, when you just didn't want to do anything. Still thinking about that time, I want you to work on this puzzle, but I don't want you to try too hard. Okay? Remember not to work your hardest.” Low-effort participants were also provided with several objects with which they could fiddle. They were periodically reminded by the research assistant to “goof off” during the task. Nicholls and Miller (1984) successfully used a similar strategy to induce low effort in child participants. After two minutes, the research assistant told the participant to stop. The research assistant then pretended to score the puzzle. Participants were told that they got 2, 3, or 4 (at random) out of 13 puzzle pieces in the right place. (A range of scores was used to prevent students from conferring with one another, discovering the deception, and revealing it to others between testing sessions.)

After giving the false feedback, the research assistant told the participant that she would find a video clip of another child in the same grade level who obtained the same score on the puzzle. The experimenter then selected a puzzle video of a single actor who exerted the opposite amount of effort from the participant but matched the participant's age, sex, and race. As in Nicholls and Miller's (1984) work, participants in the high-effort condition viewed a low-effort video, whereas those in the low-effort condition viewed a high-effort video. While watching the video clip, participants were instructed to think about two things: who is smarter (oneself or the child in video) and who worked harder.

After the video clip, research assistants administered a manipulation check to ensure that participants understood their score on the puzzle, whether they or the actor worked harder, and that both the actor and the participant obtained the same score on the puzzle.² All of the participants in both conditions correctly remembered their own score and the actor's score on the puzzle task. All but three participants (2%) regarded their own scores on the puzzle task as poor. Participants were also asked, “Did one of you work harder on the puzzle, or did you work the same?” which was rated on a 1-5 scale: 1 = I worked a lot harder; 2 = I worked a little harder; 3 = We worked the same; 4 = [Actor] worked a little harder; 5 = [Actor] worked a lot harder. Participants in the high-effort condition rated themselves as working much harder ($M = 1.55$, $SD = .81$) than did participants in the low-effort condition ($M = 4.26$, $SD = .70$), $p < .01$. Next, participants completed Question Set 1, assessing affect and motivation, effort and ability, and attributions and controllability.

Part II—Participants were shown photographs of two actors who were approximately the same age, sex, and race as the participant. The experimenter said, “One of these boys/girls works hard and one doesn't work hard. I want you to watch the video carefully to see if you can see which one is working hard and which one isn't. In the end both get 2 out of 10 problems right. They get the same score, but neither of them cheated.” Participants then watched the video of these two actors working on a math worksheet. One actor exerted high effort, the other low

²Participants who initially failed to identify that they or the actor worked harder typically claimed that both worked equally hard. In keeping with Nicholls and Miller's (1984) procedures for handling such events, research assistants simply reminded such participants of either the actor's or the participant's low effort behaviors until they understood the difference in effort. This occurred only 18.7% of the time and required only brief intervention. After the intervention, 100% of participants correctly identified who worked harder. An independent samples t-test revealed significant developmental differences in whether or not participants failed this manipulation check ($t = 3.09$, $p = .002$). Participants who failed had a mean age of 9.79 ($SD = 2.07$), whereas participants who passed had a mean age of 11.32 ($SD = 2.36$). Nicholls & Miller (1984) encountered similar developmental differences, reporting that younger children were more likely to fail the manipulation check.

effort. After the video, the photographs were left on the table. Each photograph was given a nametag to distinguish between the actors during questioning.

Participants responded to manipulation check questions (similar to those in Part I) to ensure they understood which actor worked hard and which one did not. Answers revealed that all participants knew the scores that both actors received. All but five participants (3%) regarded the actors' scores on the math worksheet as poor. Misperceptions were followed by reminders about scores and the performance-related behaviors. Upon follow-up questioning, all participants correctly recognized that the scores reflected poor performances. On a 1 to 5 scale, participants consistently rated the high-effort actor as working harder than the low-effort actor ($M = 4.88$, $SD = .50$).

Participants then responded to Question Set 2 (measuring effort-ability and attributions/controllability), while referring back to the photographs for each question. Afterwards, they were given the choice of receiving either a decorative pencil or candy, and escorted back to their classroom.

Results

Overview and descriptive statistics

The overall design included two between-subject factors: Age and Condition. We conducted all analyses using age not grade level. Age was calculated based upon birth date and date of participation to form a decimal number representing exact age (accurate to the day) at the time of study completion. Condition (high vs. low effort) pertained only to Part 1 of the study. Means, standard deviations, and correlations with age for key study variables are presented in Tables 2 and 3.

Randomization check

We checked to see if there were pretest differences between participants in the randomly assigned high-effort and low-effort conditions. Least squares regression of each pretest measure onto Condition, Age, and Age $\times$ Condition revealed no main effects or interactions on affect, self-perceived scholastic competence, or self-perceived puzzle competence ($ps > .10$).

Hypothesis 1

Our first hypothesis was that children's understanding of effort and ability as causes of negative (as opposed to positive) outcomes would become increasingly sophisticated with age, following the developmental progression described by Nicholls and Miller (1984). We scored effort/ability level from 1 to 4. At Level 1 (age 5-6), effort and ability are not differentiated and their relation to outcome is unclear; at Level 2 (age 7-9), children attribute outcome purely to effort; at Level 3 (age 10-11), children begin to distinguish between ability and effort and will inconsistently attribute outcome to one or the other, and at Level 4 (age 12 and up), ability is seen as a factor that limits the effect of effort.

In separate regressions, we examined the relation of age to two estimates of effort/ability level, one based on participants' explanations of their own puzzle performance (Self) relative to the videotaped actor, the other based on their explanations of others' performances (Others) in the math worksheet video. As shown in Table 4, age was significantly and positively related to both estimates of effort/ability level, even after controlling for sex and condition. These regressions are plotted in Figure 3.

Hypothesis 2

In our second hypothesis, we speculated that children would apply less mature conceptualizations of effort/ability when the task involved their own poor performance as opposed to the poor performances by others. Although the regression line for one's own performance (Self) appears lower than the regression line based upon the two actors (Others) in Figure 3, neither the slopes nor the intercepts for the two lines were significantly different from one another.

Hypotheses 3a, 3b, and 3c

We broadly expected the correlates of perceived ability to change with age. This translated into three related hypotheses. Hypothesis 3a specifically suggested that the relation of effort and ability to each other would vary as a function of age. That is, older children would be more likely than younger children to make low-ability inferences when high effort is followed by a poor outcome. One set of such tests was derived from the puzzle task, in which the participants themselves served in either the high- or low-effort role. Here we expected a significant interaction between Age and Condition. Least squares regression indeed revealed that the Age $\times$ Condition interaction was significant over-and-above the Age and Condition main effects for two questions: Who is smarter/better at puzzles, $\Delta F_{1,162} = 7.28$ ($p < .008$), and Who will do better on the same puzzle next time, $\Delta F_{1,162} = 4.94$ ($p < .028$). As depicted in the two graphs in Figure 4, the relation between effort (Condition) and perceived ability changed with age. Although the two graphs are fundamentally similar, the age differences manifest in slightly different ways for the two questions. When asked "Who is smarter/better at puzzles," age differences were more apparent in the high-effort condition: older children associated high effort with lower ability. When asked, "Who will do better next time," age differences were more apparent in the low-effort condition: younger children associated low effort with lesser ability. Queries about a different puzzle or a math worksheet did not show significant interactions.

A second set of tests was based on four queries from Question Set 2, which followed the video presentation of the two actors' performances on the math worksheet. High scores on these queries reflect the perception that the high effort actor is smarter or more capable than the low effort actor. As depicted in Figure 5, age was significantly negatively correlated with 3 out of 4 such inquiries. Younger children perceived the high-effort actor as generally smarter than the low-effort actor, predicted that the high-effort actor would do better than the low effort actor if they both tried again, and regarded the high-effort actor as more likely than the low-effort actor to do well on a different math worksheet. This association of effort with ability diminished at older age levels. By age 15, participants (on average) perceived that high effort coupled with a poor outcome actually implied lower ability. Only on one query ("Who would do better on a spelling test?") was the relation to age nonsignificant.

Hypothesis 3b focused on developmental changes in the degree to which effort/ability related to motivation and affect. Specifically, we expected the effect of the high-effort versus low-effort conditions on motivation and affect to be stronger for older participants. In keeping with this hypothesis, we found a significant Age $\times$ Condition interaction on motivation to try again on the puzzle task, $\Delta F_{1,162} = 5.55$ ($p < .02$). As shown in Figure 6, younger children showed essentially no association between effort and motivation. At older ages, however, motivation dropped for low-effort participants but remained high for high-effort youth. This interaction disappeared when the Condition $\times$ Ability judgment (that is, participants' ratings of who is smarter/better, themselves or the actor) interaction was statistically controlled, suggesting that the effect of Age on motivation was due to the effect of Age on ability judgments. Contrary to our hypothesis, the Age $\times$ Condition effects on sad and angry affect were not significant; however, the Age main effect on anger was significant, $\Delta F_{1,162} = 9.20$ ($p < .01$), with older

children (in both the low- and high-effort conditions) acknowledging more anger about their poor performance outcomes than did younger children.

Hypothesis 3c was that older participants would be more likely than younger participants to attribute a negative outcome following the exertion of high effort to ability-related causes. In other words, in the high-effort condition, age would positively correlate with the tendency to attribute failure to internal, stable, and global causes. A series of regression analyses revealed partial support for this hypothesis. In the high-effort condition of the puzzle task, Age was significantly and positively related to children's tendencies to attribute their failures to stable ($t_{87} = 2.58, p < .01$) and global ($t_{87} = 2.13, p < .00$) but not internal ($p > .20$) causes. The same pattern of results emerged for children's judgments about others' performances on the math worksheet task: stable ($t_{162} = 3.07, p < .001$), global ($t_{162} = 2.99, p < .01$), but not internal ($p > .20$). These relations are depicted in Figure 7.

Discussion

Three major results derived from this study. Our first hypothesis, Hypothesis 1, was supported insofar as age was significantly related to the maturity and sophistication of children's understanding of the reciprocal relation between effort and ability, thus extending Nicholls' earlier (1978; Nicholls & Miller, 1983, 1984) work to situations involving negative outcomes. Our corollary hypothesis (Hypothesis 2) was not supported in that children's understanding of effort/ability was not significantly less mature when focused on one's own performance as opposed to the performance of others. Finally, Hypothesis 3 about developmental changes in the relation of effort to other constructs was largely supported. At different ages, we observed changes in the relation of effort (a) to ability judgments about self and others, (b) to motivation to try again after failure, and (c) to the tendency to attribute failure to stable and global causes. We elaborate on each of these findings below.

In support of Hypothesis 1, age significantly predicted Nicholls' effort/ability levels in situations where performance outcomes were negative. Older participants understood the reciprocal relation between effort and ability better than did younger children. The relation between one's age and sophistication of estimated effort/ability level was evident in two kinds of situations: one in which participants judged their own ability and another in which participants judged the relative ability of others. These results extend the work of Nicholls (1978) by focusing on situations in which performance outcomes were negative. How children understand effort and ability in relation to negative events is especially important because the occurrence of negative events is crucial in the emergence of a variety of problematic outcomes, including learned helplessness and depression (Abramson et al, 1989; Weiner, 1985). If what children mean by their ability judgments changes with age, then special care must be taken as investigators apply such theories to younger and younger age levels.

Our data did not support Hypothesis 2, that children would evince a less mature understanding of effort and ability when focused on personal failure situations, as opposed to failures by others. Learned helplessness and depression involve both the perception of diminished ability in oneself as well as the perception of superior ability in others. The current results suggest that children's conception of both their own abilities and others' abilities change qualitatively with age. What children mean when they say they are less capable and what they mean when they say others are more capable undergoes age-related changes. This is not to say that self-serving bias does not exist in childhood. It clearly does (Mezulis et al, 2004). Instead, it means that self-serving bias does not moderate the developmental progression of children through estimates of Nicholls' (1978) effort/ability levels. Consequently, when older and younger children make similar sounding judgments about themselves or others, we cannot assume that these judgments reflect similar underlying conceptualizations across ages.

Our third hypothesis was that developmental maturation of children's understanding of effort and ability would be reflected in age-related changes in the relation of these variables to each other, to motivation, to affect, and to various causal attributional dimensions. This hypothesis was largely supported. For older children, our experimental manipulation of effort followed by failure feedback was associated with (a) a decrease in perceived ability, (b) an increase in motivation, and (c) increases in the tendency to attribute failure to stable and global causes. For younger children, the opposite pattern emerged. The meaning of a psychological construct is reflected in its relation to other constructs with which it is theoretically related (Cronbach & Meehl, 1955; Nesselroade & Ghisletta, 2003). The fact that the correlates of effort and ability change with age suggests not only that these constructs change but that the theoretical, nomological net in which they are embedded also changes with development. Here we consider the developmental implications of these findings for two theories: one pertaining to self-handicapping, another pertaining to depression.

Jones and Berglas (1978) suggested that some individuals, especially those with low self-perceived competence, make choices that facilitate an external attribution in the event of failure. Sometimes such self-handicapping strategies also facilitate failure as part of a larger self-fulfilling prophecy. More recently, Eccles, Wigfield, and others described a similar phenomenon in youth, in which children sometimes adopt a low-effort strategy in challenging achievement-oriented situations, so as to protect themselves in the event of failure: "I could have done better if I had tried harder" (Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Wigfield & Eccles, 2000). This strategy is more evident among older children. The results of the current study support a developmental explanation for this phenomenon. When we required older children to apply low effort, they had an excuse for their poor performance (i.e., I didn't work hard). Given their more sophisticated understanding of effort and ability, they could rationalize their failure as a result of low effort, whereas their high-effort counterparts could only attribute their failure to lack of ability; in the face of that personal threat, they felt more motivated to try again. Conversely, younger children who do not understand the reciprocal relation between effort and ability effectively had no such excuse. For them, failing at a task implied they had low ability, despite the fact that they had applied low effort. Without an understanding of how low effort provides an excuse for poor performance, their motivation remained high to redeem themselves by trying the task again. Trying again could lead to a success, which would affirm their self-perceived ability. In other words, age-related differences in the understanding of effort and ability lead older and younger children to adopt very different self-protection strategies.

Developmental changes in the correlates of effort and ability may also have implications for attributional models of depression (e.g., Abramson, Seligman, & Teasdale, 1978; Abramson et al, 1989; Weiner, 1985), at least as they are applied to children. Abramson et al.'s (1989) hopelessness theory of depression suggests that individuals who tend to make stable and global attributions for negative events in their lives are at increased risk for at least a hopelessness subtype of depression. Interestingly, *ability* represents what is probably the most common internal, stable, global attribution, whereas *effort* represents the prototypical internal, unstable, specific attribution. Thus the hopelessness theory of depression would anticipate that individuals who attribute negative events to their low ability (a stable and internal cause) would be prone to depression, whereas individuals who attribute such events to low effort would be relatively resistant to depression. Similar arguments have been made by Janoff-Bulman (1979) regarding behavioral versus characterological self-blame, and by Niedenthal, Tangney, and Gavanski (1994) regarding guilt versus shame. The application of these theories to younger ages, however, assumes that ability and effort attributions mean the same thing to children as they do to adults. The current study coupled with the prior work by Nicholls and Miller (1983, 1984) suggests that this is not so. Inferences about ability following failure feedback appear to mean very different things depending upon one's age. The application of such

cognitive theories about depression (Abramson et al, 1989; Janoff-Bulman, 1979; Niedenthal et al, 1994) to younger ages may therefore require substantial modification in light of the child's level of cognitive development.

Several shortcomings of the current study suggest avenues for future research. First, we used age as a proxy for development. Changes in children's understanding of ability and effort are likely due to a combination of factors, some of which represent developmental processes (e.g., cognitive development, socialization) and others which represent individual difference characteristics (e.g., intelligence, personality).

Second, more thorough measures of several of our constructs would be valuable. A more refined assessment of children's positive and negative affect might generate stronger support for our hypothesis that high effort followed by a poor outcome will have stronger impact on negative mood in older than younger children. For example, observational measures of children's affect during failure feedback may be less subject to demand characteristics and social desirability response bias, compared to our interview-based assessments. In a similar manner, our measure of motivation could be supplemented with behavioral observation (e.g., do children persist on the puzzle task if given the opportunity?). If positive affect and task persistence decreases with age, the implications for learned helplessness would be significantly enhanced.

Third, our sample was primarily Caucasian, a factor that may limit the generalizability of our results to other populations. Future research should examine more diverse populations. Mezulis et al.'s review suggests that causal attributions and self-serving bias do vary from culture to culture (2004). Additionally, Hufton, Elliott, and Illushin's (2002) work suggests that the relative importance of effort and ability differs across cultures and geographical regions. Understanding the development of such cultural differences would help to illuminate key aspects of the socio-cultural milieu in which children's understanding of ability emerges.

Fourth, in both our study and Nicholls' original study, the low-effort induction (i.e., where an adult gives verbal instructions not to work hard) may have seemed artificial to participants. Despite the fact that most of our hypotheses were at least partially supported, future studies could utilize a more naturalistic low-effort induction, if only to test the ecological validity and real-world generalizability of the current results.

Fifth, the current study focused on children in grades 2, 4, 6, and 8 (ages 5 to 15); however, our results suggest that a wider age range might have generated even stronger support for our hypotheses. Nicholls and Miller's (1984) lowest and highest effort/ability levels were somewhat under-represented. Many of our youngest participants exceeded the lowest level, and many of our oldest participants did not quite reach the highest level of understanding the relation between effort and ability. Inclusion of younger and older participants could alleviate potential attenuation due to partial restriction of range.

Finally, we observed some within-age variability in effort/ability level, with some younger children scoring quite high and some older children scoring quite low. We speculate that this variability may be due to individual differences in children's rate of cognitive development, level of experience, and/or overall intelligence; however, we did not obtain such measures in the current study. Future research should assess such individual difference variables, insofar as understanding the within-age variability in effort/ability level could be illuminating.

Acknowledgements

This research was supported in part by grant numbers R01MH64650 from the National Institute on Mental Health and P30HD15052 from the National Institute of Child Health and Human Development to Vanderbilt University.

References

- Abramson LY, Metalsky GI, Alloy LB. Hopelessness depression: A theory-based subtype of depression. *Psychological Review* 1989;96:358–372.
- Abramson LY, Seligman MEP, Teasdale JD. Learned helplessness in humans: Critique and reformulation. *Journal of Abnormal Psychology* 1978;87:49–74. [PubMed: 649856]
- Cole DA, Maxwell SE, Martin JM, Peeke LG, Seroczynski AD, Tram JM, Hoffman KB, Ruiz MD, Jacquez F, Maschman T. Age and gender effects in multiple domains of child and adolescent self-concept: A cohort sequential longitudinal design. *Child Development* 2001;72:1723–1746. [PubMed: 11768142]
- Conley CS, Haines BA, Hilt LM, Metalsky GI. The Children's Attributional Style Interview: Developmental tests of cognitive diathesis-stress theories of depression. *Journal of Abnormal Child Psychology* 2001;29:445–463. [PubMed: 11695545]
- Cronbach L, Meehl P. Construct Validity in Psychological Tests. *Psychological Bulletin* 1955;52:281–302. [PubMed: 13245896]
- Dweck C, Leggett E. A Social-Cognitive Approach to Motivation and Personality. *Psychological Review* 1988;95:256–273.
- Fincham F, Cain K. Learned Helplessness in Humans: A Developmental Analysis. *Developmental Review* 1986;6:301–333.
- Harter, S. Manual for the Self-Perception Profile for Children. Denver: University of Denver; 1985.
- Heyman G, Dweck C. Children's Thinking about Traits: Implications for Judgments of the Self and Others. *Child Development* 1998;69:391–403. [PubMed: 9586214]
- Huften NR, Elliott JG, Illushin L. Educational motivation and engagement: Qualitative accounts from three countries. *British Educational Research Journal* 2002;28:265–289.
- Jacobs J, Lanza S, Osgood D, Eccles J, Wigfield A. Changes in Children's Self-Competence and Values: Gender and Domain Differences across Grades One through Twelve. *Child Development* 2002;73:509–527. [PubMed: 11949906]
- Janoff-Bulman R. Characterological versus behavioral self-blame: Inquiries into depression and rape. *Journal of Personality and Social Psychology* 1979;37:1798–1809. [PubMed: 512837]
- Jones E, Berglas S. Control of attributions about the self through self-handicapping strategies: The appeal of alcohol and the role of underachievement. *Personality and Social Psychology Bulletin* 1978;4:200–206.
- Kun A. Development of the magnitude—covariation and compensation schemata in ability and effort attributions of performance. *Child Development* 1977;48:862–873.
- Laurent J, Cantanzaro JS, Thomas JE, Rudolph DK, Potter KI, Lambert S, Osborne L, Gathright T. A measure of positive and negative affect for children: Scale development and preliminary validation. *Psychological Assessment* 1999;11:326–338.
- Marsh HW, Cairns L, Relich J, Barnes J, Debus RL. The relationship between dimensions of self-attribution and dimensions of self-concept. *Journal of Educational Psychology* 1984;76:3–32.
- Mezulis A, Abramson LY, Hyde J, Hankin B. Is There a Universal Positivity Bias in Attributions? A Meta-Analytic Review of Individual, Developmental, and Cultural Differences in the Self-Serving Attributional Bias. *Psychological Bulletin* 2004;204:711–747. [PubMed: 15367078]
- Muris P, Meesters C, Fijen P. The Self-Perception Profile for Children: further evidence for its factor structure, reliability, and validity. *Personality and Individual Differences* 2002;35:1791–1802.
- Nesselroade, JR.; Ghisletta, P. Structuring and measuring change over the life span. In: Staudinger, UM.; Lindenberger, U., editors. *Understanding human development: Dialogues with lifespan psychology*. Dordrecht, Netherlands: Kluwer Academic Publishers; 2003. p. 317–337.
- Nicholls JG. The development of the concepts of effort and ability, perception of academic attainment, and the understanding that difficult tasks require more ability. *Child Development* 1978;49:800–814.
- Nicholls JG. Quality and equality in intellectual development: The role of motivation in education. *American Psychologist* 1979;34:1071–1084.
- Nicholls JG, Miller AT. The differentiation of the concepts of difficulty and ability. *Child Development* 1983;54:951–959.

- Nicholls JG, Miller AT. Reasoning about the ability of self and others: A developmental study. *Child Development* 1984;55:1990–1999.
- Nicholls JG, Patashnick M, Mettetal G. Conceptions of ability and intelligence. *Child Development* 1986;57:636–645.
- Niedenthal P, Tangney JP, Gavanski I. “If only I weren't” versus “If only I hadn't”: Distinguishing shame and guilt in counterfactual thinking. *Journal of Personality and Social Psychology* 1994;67:585–595. [PubMed: 7965606]
- Piaget, J. *The moral judgment of the child*. Oxford: Harcourt, Brace; 1932.
- Rholes WS, Blackwell J, Jordan C, Walters C. A developmental study of learned helplessness. *Developmental Psychology* 1980;16:616–624.
- Smiley PA, Dweck CS. Individual differences in achievement goals among young children. *Child Development* 1994;65:1723–1743. [PubMed: 7859551]
- Weiner B. An attributional theory of achievement motivation and emotion. *Psychological Review* 1985;92:548–573. [PubMed: 3903815]
- Wigfield A, Eccles J. Expectancy-Value Theory of Achievement Motivation. *Contemporary Educational Psychology* 2000;25:68–81. [PubMed: 10620382]

Figure 1.
Procedural flowchart.

Figure 2.
Acrylic puzzle design.

Figure 3.
Nicholls' effort/ability level (derived for self and other) as a function of age.

Figure 4.

Ability judgments of Self vs. Other in the puzzle task as a function of Age and Condition: high effort (HE) vs. low effort (LE).

Figure 5.

Perceived ability of others in high-effort and low-effort conditions during the math worksheet task as a function of Age.

Figure 6.

Relation of high effort (HE) vs. low effort (LE) Condition to motivation during the puzzle task as a function of Age.

Figure 7.
Relation of attributional dimensions to ability judgments in the puzzle task (Self) and the math worksheet task (Other) as a function of Age.

Table 1

Demographics

Grade	N	Gender (% Female)	Age (SD)
2	47	44.7%	8.09 (.50)
4	37	59.5%	10.15 (.37)
6	42	35.7%	12.23 (.40)
8	40	40.0%	14.21 (.48)
Total	166	44.6%	11.07 (2.37)

Table 2
Means, Standard Deviations, and Correlations with Age for Pretest and Puzzle Task Measures by Condition

Measure	Low Effort (LE)		<i>r</i> _{Age}	High effort (HE)		<i>r</i> _{Age}
	<i>M</i>	<i>SD</i>		<i>M</i>	<i>SD</i>	
Pretest measures						
Positive affect (PANAS)	16.39	4.06	-.53**	17.34	3.51	-.46**
Negative affect (PANAS)	7.25	2.04	-.09	6.71	1.79	.23*
Self-perceived academic competence	18.66	3.05	.05	18.47	3.07	.01
Self-perceived puzzle competence	8.45	2.80	.15	8.48	2.74	.35**
Question Set 1						
Puzzle feelings (1 – 4, high = sad/angry)	1.58	0.73	.18	1.47	0.58	.16
Puzzle motivation (1 – 4, high = motivated)	3.08	1.02	-.45**	3.35	0.89	-.15
Who is smarter/better: 1 = Other, 5 = Self						
...1 st probe	2.84	0.68	-.03	3.57	0.65	-.13
...2 nd probe	3.10	0.69	.12	3.29	0.82	-.29**
Nicholls' effort/ability levels (1 – 4)	2.51	0.89	.18	2.42	0.88	.38**
Who would do better: 1 = Other, 5 = Self						
...if you both tried again?	3.53	0.96	.25*	3.27	1.01	-.08
...on a different puzzle?	3.24	0.79	.07	3.46	1.02	-.17
...on a math worksheet?	3.61	0.99	-.03	3.83	1.15	-.11
Is reason for bad score (1 – 4)						
...internal (vs. external)	2.86	0.97	.26*	3.12	0.84	-.08
...stable (vs. unstable)	2.39	0.98	.16	2.70	0.95	.17
...global (vs. specific)	1.83	0.92	.25*	1.61	0.70	.22*
...controllable (vs. uncontrollable)	3.30	1.27	.22	2.79	1.48	.18

^a 100% after follow-up clarifications.

* $p < .05$.

** $p < .01$.

Table 3

Means, Standard Deviations, and Correlations with Age for Measures Administered after Two-Person Math Worksheet Video

Question Set 2	<i>M</i>	<i>SD</i>	<i>r_{Age}</i>
Who is smarter/better: 1 = low effort (LE) actor, 5 = high effort (HE) actor			
...1 st probe	3.32	1.12	-.37**
...2 nd probe	2.96	1.11	-.36**
Nicholls' effort/ability levels (1 – 4)	2.69	0.91	.37**
Who would do better: 1 = LE actor, 5 = HE actor			
...if you both tried again?	3.01	1.18	-.21**
...on a different math worksheet?	3.24	1.04	-.26**
...on a spelling test?	3.48	0.96	-.14
Is reason for low effort actor's bad score (1 – 4)			
...internal (vs. external)	2.53	1.27	-.05
...stable (vs. unstable)	3.16	0.85	.17*
...global (vs. specific)	2.57	0.96	.28**
...controllable (vs. uncontrollable)	3.60	1.02	.15
Is reason for high effort actor's bad score (1 – 4)			
...internal (vs. external)	2.98	0.93	.09
...stable (vs. unstable)	2.62	0.95	.20**
...global (vs. specific)	1.92	0.87	.15
...controllable (vs. uncontrollable)	3.53	1.10	-.02

*
 $p < .05$.

**
 $p < .01$.

Table 4
Regression of Effort-Ability Estimates onto Age, Controlling for Sex and Condition.

Predictor	B	SE(B)	B	p <	Mult. R
DV = Effort/Ability based on Self					
Age	.12	.03	.30	.001	.34***
Sex	-.24	.14	-.14	ns	
Condition	-.06	.14	-.04	ns	
DV = Effort/Ability based on Others					
Age	.14	.03	.37	.001	.37***
Sex	.08	.14	.04	ns	
Condition	.01	.14	.01	ns	

 $p < .001$