DOCUMENT RESUME

ED 274 434 PS 016 046

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TITLE Measuring Developmental Levels of Understanding of Ability and Effort.
PUB DATE Apr 86
NOTE 20p.; Paper is a supplement to the roundtable discussion presented at the Annual Meeting of the American Educational Research Association (67th, San Francisco, CA, April 16-20, 1986).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Ability; *Abstract Reasoning; *Child Development; *Developmental Stages; Photographs; Protocol Analysis; *Research Methodology; Success; Videotape Recordings
IDENTIFIERS *Developmental Patterns; *Effort

ABSTRACT

Discussed are research methods used to measure developmental changes in children's reasoning about ability. While adults generally differentiate ability, effort, luck, and task difficulty as causes for success and failure, children progressively think that effort or outcome is ability (level 1), that effort is the cause of performance outcomes (level 2), that effort and ability are partially different (level 3), and that ability is capacity (level 4). Typically, level 1 thinking predominates among 5-year-old children, while most children advance to level 4 at about 11 or 12 years of age. Techniques used to identify and assess developmental levels in children's reasoning about ability required subjects to compare the abilities of two children who applied varied levels of effort and achieved varied outcomes. In initial studies, films or videotapes were shown individually to subjects. Later research used a series of six pictures frequently depicting one child "goofing off." This report illustrates and discusses examples of children's typical response protocols at each level of reasoning, reports rationale for key questions asked in the interview situation and for scoring procedures, and explores the relationship of reasoning level to other variables, such as expectations of teacher approval for effort and performance impairment after failure. (RH)

Measuring Developmental Levels of Understanding of Ability and Effort

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This manuscript is a supplement to a roundtable discussion presented at the meeting of the American Education Research Association, April, 1986. During this discussion, videotapes were presented and discussed to illustrate methods of interviewing children to assess their understanding of ability. It is important to note that the manuscript by itself was not intended to fulfill the purposes of the roundtable discussion.

Measuring Developmental Levels of Understanding of Ability and Effort

Achievement motivation is distinguished from other forms of motivation by the incentives associated with it. The incentive for achievement is competence or the perception of competence (see Nicholls, 1984; Nicholls & Miller, 1984a for discussion). We make judgements about competence based upon our schemes or conceptions of ability. Thus, variation in achievement motivation will result from variations in reasoning about ability. It follows that the development of the concept of ability is central to the development of achievement motivation.

We (see Nicholls & Miller, 1984a for review) focused attention on conceptions of ability in the context of other factors to which people attribute success and failure. Adults generally distinguish or differentiate ability, effort, luck, and task difficulty as causes for success and failure (Weiner, 1974). Children, on the other hand, use these concepts differently. The following is a discussion of methods we have used to measure developmental changes in understanding of effort and ability.

Reasoning about Effort and Ability

Four levels of reasoning about effort and ability were identified (Nicholls, 1978; Nicholls & Miller, 1984b). A description of these levels appears in appendix A.

The technique used to identify and assess levels of reasoning about ability utilizes a situation where the child must compare the abilities of children who apply varied levels of effort and achieve varied outcomes. In the first two studies, films or videotapes were shown to the child with two children working on the same task showing obvious differences in level of effort. As an alternate form, later research used a series of pictures depicting two children working on a task, with one child "goofing off" in four of the six snapshots (Miller, 1985).

While it is somewhat more realistic for children to make judgements about films or videotapes of actors, the pictures hold several advantages. The child's level of reasoning can be assessed more quickly (about 5 minutes) using pictures. It is also quite helpful for children to be able to refer to the pictures and the differences in effort while discussing outcomes. This is especially true with younger children who may doubt their memory when events have unexpected outcomes (e.g., lower effort resulting in higher performance).

Regardless of the method of presentation of stimuli, children view two students working on the same task for the same amount of time and attaining the same score. A variation with the harder worker getting a lower score is necessary if one is to distinguish level 1 from level 2 reliably (Nicholls, 1978).

The following are some descriptions of typical response protocols. Generally, a child who fully understands capacity (Level 4) can be identified readily. In the following interview our standard interview questions only were used and the student is logically consistent in her responses.

"Is one smarter at these puzzles or are they the same?"

"This [lazier] one is smarter."

"How can you tell?"

"She looked around but got the same number right.

"How come they both got the same score when one worked hard and one didn't work hard?"

"This one [lazier] was smarter."

"What would happen if they both worked hard? Would one get more or would they both get the same?"

"This one [lazier] would get more."

"How can you tell?"

"The other one already tried hard."

"So do you think one of them is smarter?"

"Her [lazier]."

This is a clear example of complete differentiation of the concepts of effort and ability (see level 4, Appendix A). A significant proportion of the students who initially give the impression that they lack the insights illustrated in the above interview, "wake up" after being asked, "How come they got the same . . .?" (Nicholls & Miller, 1984b). For example:

"Is one smarter at these puzzles or are they the same?"

"The same."

"How can you tell?"

"Since they got the same score."

"How come they both got the same score when one worked hard and one didn't work hard?"

"He [lazier one] didn't have to think as hard to get the answers."

"What would happen if they both worked really hard? Would one get more or would they both get the same?"

"He'd [lazier one] do more."

"How can you tell?"

"Because he got them quick."

"So do you think one of them is smarter?"

"They're the same. Well, he [lazier] is probably a little smarter cause he figures out the problems easier."

Others give the impression that they are about to wake up (and thereby be categorized as level 4) but do not, even when the interview is repeated with film or photos of different children.

"Is one smarter?"

"They're the same."

"How can you tell?"

"Cause they both got 10."

"How come they both got the same score when one worked hard and one didn't?"

"Maybe he [lazier] is smart but playing around."

"What would happen if they both worked really hard? Would one get more or would they get the same?"

"Same."

"How can you tell?"

"If the one playing around would have tried, he would get the same. He wouldn't get worse."

"So do you think one of them is smarter?"

"They're the same."

Although the student gave a hint of differentiation of effort and ability, where the lazier actor is seen as "smart but playing around," this indication was not sustained. This illustrates level 3 in that the student showed a glimmer of understanding that the effect of effort on performance depends upon individual differences in ability. But such glimmers are absent in many cases. For example:

"Is one of them smarter or are they the same?"

"This one [harder worker] is."

"How can you tell?"

"He's doing his work."

"How come they both got the same score when one worked hard and the other one didn't work hard?"

He [lazy one] copied."

Well, yes, that sometimes happens, but we didn't want to show you anyone who copies and this boy doesn't do that."

"He [lazy one] must have thought about it."

"What would happen if both worked really hard? Would one get more or would they both get the same?"

"The same."

"How can you tell?"

"If they both work hard and they are good workers they can get it done."

"So do you think one of them is smarter."

"They are the same. Both are smart because they both got their work done and they both got eight right."

Given the above information, it is hard to be sure whether this interview illustrates level one or level two. It seems that the student expects equal effort to lead to equal results (despite the difference in effort that he acknowledged at the outset of the interview). And, where scores are equal he tries to account for this in terms of equal effort--by suggesting that the boy who was (or seemed) lazy actually thought about the work. It seems that this child differentiates effort as a cause

from outcomes and thus illustrates level 2. But it is hard to be sure whether he simply expects effort and performance to be correlated as do level 1 students. To provide a better test of the differentiation of the concept of effort as a cause from outcomes, a further problem was used. In this the harder worker solved 2 out of 10 and the lazier student scored 8 (Nicholls, 1978; Nicholls et al., in press). Here is how the above child dealt with this additional problem.

"Is one of them smarter?"

"He [lazier, higher scorer] is."

"How can you tell?"

"He got 8 and he got 2."

"How come the one who didn't work so hard got more right?"

"This [lazier] one is smarter."

"What does that mean?"

"He knows more."

"What would happen if they both worked really hard...would one get more...?"

"They'd get the same."

"How can you tell?"

"If they both worked hard and listened they'd get the same."

"So do you think one of them is smarter?"

"Him [lazier]."

This boy still expected equal effort to lead to equal outcomes, despite the fact that we had just showed him a blatant violation of this rule. But he acknowledged the fact that it

doesn't always follow. That is, effort and outcomes are not confounded to the extent that they are at the least differentiated level. This least differentiated position is illustrated by the following partial protocol from a girl whose responses to the initial situation (where the actors scored the same as each other) were almost identical to those of the previous student. But, when shown the harder worker scoring 2 and the lazier student scoring 8, she chose the harder worker as more able because "She is working and not playing."

"How come the one who didn't work so hard got more right?"

"She got real busy after she was playing around."

"How come she [the one who worked less] got more than the other one?"

"She worked harder."

"What would happen if they both worked really hard...would one get more...?"

"Get the same."

"How can you tell?"

"They'd both be working."

"So do you think one of them is smarter?"

"She [harder worker] is."

This response has a hint of level 2 reasoning in that the girl implies that harder work causes higher scores. But the evident difficulty with the notion that a harder worker might score less or be less able is typical of level 1. It suggests that when effort and outcome do not go together, the child appears unable to accommodate this. It is not that level 1

children don't recognize the discrepancy at some level. Many of them express surprise mingled with outrage when they observe (in the film or videotape) that the student they were told scored more is "goofing off." Cries of "What!" "Huh!" and such indicate both their expectations about the world and the fact that they recognize a violation of this expectation. But this recognition does not lead them to say that the harder worker gained a lower score and is less able as do level 2 students.

One always finds a few protocols that contain elements of more than one level. This is hardly surprising. If meanings are constructed through a process of detecting and resolving contradictions between one's schemes and between these schemes and one's perception of the world, periods of confusion and inconsistency are inevitable. Despite this, it is relatively easy to categorize protocols into the four levels with a high level of agreement between independent raters (Miller, 1985; Nicholls, 1978; Nicholls & Miller, 1984b; Nicholls, Patashnick, & Mettetal, 1986).

Scoring is made much easier if as protocols are categorized based upon the overall interview, they are placed in piles--one for each level and (usually) extra piles for the undecided ones. On going through protocols in these piles, one at a time, it becomes increasingly easy to see the protocols that don't belong and those that do. This makes scoring much easier and more reliable than if you try to judge each one on its own. We typically go through each pile several times before being satisfied that we have obtained the best categorization

possible. We have always had two people complete the categorization independently and then we take an additional look at those where there is disagreement.

Most important to obtaining categorizable protocols is the ability to conduct the interview in a fashion that insures subjects respond meaningfully to the questions. If the child gives a nonsensical or unclear response or fails to respond to the stimuli, it may be necessary to ask probing questions to insure that the child is reasoning about the scenario as it is intended. Thus, careful attention to responses to each question is warranted.

1) "Is one of these children working harder, or are they working the same?"

This question is asked primarily to insure that children register the information in the intended fashion. We cannot begin the interview if there is any confusion about which child tried harder. On infrequent occasions when children fail to respond accurately to this question, probing questions such as "Who was working hardest in this picture? In this one?" are asked to insure that children correctly interpret the stimuli.

2) "Is one of them smarter at the puzzles or are they the same? How can you tell?"

This question provides the first major piece of information regarding the information the child uses to infer ability. The level 1 child centers on the most apparent difference in the children that is related to being smart. Generally, they thus judge the hard worker to be smarter. Less commonly, they may focus on outcome or even size (She is smarter cause she's big).

The level 2 child expects equal effort to result in equal outcomes. Trying to ignore either the level of effort or the outcome, they judge the two to be the same or that the hard worker is smarter because hard work leads to getting things right.

Children at level 3 and 4 will generally note that equal performance with less effort implies greater ability, although level 3 children will do so less consistently.

3) "How come they both got the same score when this one worked hard and this one didn't?"

This is probably the most critical question for distinguishing levels 2, 3 and 4. The child at level 2 is confronted with a problem which contradicts his/her conception of ability and effort. Frequently, the child will try to deny the apparent differences in effort (This girl worked real hard here.) or try to escape the problem (She cheated). The interviewer should not allow the child to escape the contradiction without confronting it, and thus an appropriate response might be, "Well that sometimes happens, but in this case we are certain that neither child cheated.

Because this question cannot be adequately answered with level 2 reasoning, it promotes the use of the highest level of reasoning of which the person is capable. Consequently, children at level 3 or 4 who sometimes respond to the first question as if they were at level 1 or 2 often "wake up" and apply higher levels of reasoning at this point.

Level 3 children frequently utilize concepts less refined to explain this situation; e.g., faster, knew the problems better, etc. To the child at level 4, this example is a predictable example of how ability increases the effectiveness of effort for the child who did not work hard, and limits the effectiveness of effort for the child who worked hard.

4) "What would happen if they both worked really hard? If they did some more puzzles and they both worked hard, would one get more or would they both get the same? How can you tell?"

Children at level 1 center on the obvious cue related to ability and indicate that hard workers will do the best. Level 2 children believe that effort is the cause of outcomes, and thus equal effort leads to equal outcome. Level 3 children who explained equal outcomes in terms of faster or better understanding will frequently fail to apply this differentiation to this question. They generally conclude that they will both get the same scores if they try their hardest. Children at level 4 recognize that the smarter child who applied little effort would gain most from trying their hardest.

5) "So, do you think one of them is smarter or are they the same?"

This question is a repeat of question number 2. About one-third of the children changed their responses from question 2 to question 5. Generally this reflected a change toward more mature reasoning, with two-thirds of those changing shifting to saying that the lazier child is smarter. Only one child out of 30 who picked the lazier student as smarter at first asking changed his/her answer (Nicholls & Miller, 1984b).

It is most reasonable to assume that the less mature responses that occur when first asked which child is smarter are examples of performance error. The role of performance error in influencing our theories of qualitative change has not been adequately addressed from the perspective of measurement theory (see Miller, March, 1982). If we merely counted the mature responses from the adult perspective (score of 1 to 5), we might find results that appear to indicate a continuous (quantitative) development of improved reasoning about ability rather than a qualitative change in reasoning about ability. If, on the other hand, we are looking for reasoning capacity, we realize that people do not always utilize their capacity; that there is performance error. Thus a global scoring judgement is made using the information believed to best represent the persons reasoning capacity. Had question 1 been used as the sole source of our judgement, maturity would have been underestimated. Had the average or number of mature responses been used, the character and essence of the child's reasoning capacity would have been sacrificed.

The analysis of individual, objective responses has been of interest in describing the structure of reasoning and testing for the influence of experimental manipulations of reasoning. However, of greatest interest and utility in a broader domain of research on achievement behavior is the global evaluation of level of reasoning about effort and ability. Generally, inter-rater agreement on global evaluation of interview protocols has been quite high; 90% in Nicholls, 1978; 92% in

Nicholls & Miller, 1984b; and 96.6% in Miller, 1985 (Miller only distinguished levels 1 & 2 from 3 & 4).

While some specific responses may be influenced by self interest when reasoning about the self, the general reasoning that is applied appears to remain consistent whether reasoning about self or others (Nicholls & Miller, 1984b)

Typically, level 1 predominates among five year old children while most children advance to level 4 at about 11 or 12 years. Substantial variation from one school to another in reasoning about about effort and ability is possible. Nicholls & Patashnick (unpublished data) found wide variations in portions of fifth graders capable of reasoning about ability. However, whether this variation is a function of population differences or school experiences is difficult to determine.

Level of reasoning has been shown to be related to expectations of teacher approval for effort (Nicholls, 1978). While less mature children expected high approval for success with high effort and low ability or low effort and high ability, mature children expected less approval for success with low effort. While ratings of effort in spelling and ability were positively related for children below level 3, these ratings were unrelated for more mature children suggesting greater differentiation of effort and ability (Miller, 1982). Children in levels 1 and 2 invariably prefer to be like the harder worker rather than the lazier student, in spite of the fact that both attain equal scores (Nicholls et al, in press). While older children often express mixed feelings, they see the value of

being the lazier student; "I'd like to be him (the lazier one). Then I'd work hard and do even better".

Ego defensive performance impairment after failure occurs when subjects reduce effort, withdraw from a task, or are distracted out of concern for appearing low in ability. This form of performance impairment would occur when attributions to ability become distinguished from attributions to high effort, and high effort no longer implies higher ability. This form of performance impairment after failure was found only among children in levels 3 & 4 (Miller, 1985).

A more detailed overview of developmental changes shows that these findings, and the levels of reasoning about effort and ability are consistent with other research on age trends in cognition, affective responses, and behavior. For a more comprehensive discussion, see Nicholls & Miller, 1984a.

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Appendix A

Level 1: Effort or Outcome is Ability

Effort, ability, and outcome are imperfectly differentiated as cause and effect. Explanations are tautological. Children center on effort (people who try harder are seen as smarter even if they get a lower score) or on outcome (people who get a higher score are said to work harder--even if they do not--and are seen as smarter).

Level 2: Effort is the Cause of Performance Outcomes

Effort and outcome are differentiated as cause and effect. Effort is the prime cause of outcomes: equal effort is expected to lead to equal outcomes. Ability, in the sense of capacity which can increase or limit the effectiveness of effort, is not conceived as a cause.

When people get the same score but differ in effort, this is seen as due to compensatory effort by the student who tried less (e.g., she/he worked really hard for a while, worked at the end, might have started earlier, or must have been thinking while fiddling) or as due to misapplied effort by the person who tried harder (e.g., she/he tried too hard or went too quickly and made mistakes).

Level 3: Effort and Ability Partially Differentiated

Effort is not the only cause of outcomes. Explanations of equal outcomes following different effort involve suggestions such as: The person trying less is faster, brighter, has a better understanding, or is naturally good at the activity. These explanations imply the conception of ability as capacity; they imply that high ability can compensate for lack of effort and that low ability limits the effect of effort. These implications are not, however, systematically followed through. Despite such explanations, children may assert that students gaining equal scores after unequal effort are as smart as each other or that harder workers are smarter and that students would get the same scores if they worked as hard as each other. Level 3 does not have a clear logic of its own in the sense that the others do. It has the appearance of a transition level.

Level 4: Ability is Capacity

Ability and effort are clearly differentiated. Ability is conceived as capacity which, if low, may limit or, if high, may increase the effect of effort on performance. Effort and ability are seen as interdependent causes of outcomes; higher ability means that less effort is needed to achieve a given outcome and thusly, less effort may be taken to imply higher ability under some circumstances.