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THE RELATIONSHIP BETWEEN OPERATIONAL LEVEL AND CHILDREN'S COMPREHENSION, APPRECIATION AND MEMORY FOR COGNITIVE HUMOR

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THE RELATIONSHIP BETWEEN OPERATIONAL LEVEL AND CHILDREN'S COMPREHENSION, APPRECIATION AND MEMORY FOR COGNITIVE HUMOR

by

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Abstract

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by

Istar Schwager

Adviser: Dr. David Bearison

The present study investigates the role of cognitive functioning in humor development. Past research on humor development has indicated that intellectual maturity is a factor in humor comprehension and appreciation, but has not examined the relationship of intellectual maturity to memory for humor.

In the present investigation, the cognitive functioning of subjects was matched with the cognitive demands of the task. The subjects comprised 80 children. Sixty (60) of them were 6 to 9 year olds who were either preoperational in both class inclusion and weight conservation; operational in both areas; or operational in class inclusion but not weight conservation. Older children, age 10 to 12 comprised the rest of the sample. They were operational in both areas. Subjects were presented with jokes based on class inclusion and weight conservation discrepancies. Assessments were

made of expressive and evaluative appreciation and comprehension for the humor. Subjects were asked to retell the jokes five minutes and then ten to fourteen days after the original presentation. Recall responses were evaluated for the inclusion of the operative discrepancy and for the retention of specific content elements.

Results of the study partially confirm the hypotheses that operational level is predictive of humor comprehension, appreciation and recall. A priori comparisons were conducted to analyze the data. Comprehension provided the most sensitive gauge of intellectual ability. Expressive appreciation and recall for the operative incongruities were greater among same age children who were operational than those who were preoperational. Operational 6 to 9 year olds demonstrated significantly greater expressive and evaluative appreciation than did operational 10 to 12 year olds for whom the humor was not as challenging.

Five minutes after presentation of the jokes, memory for the operative incongruities was significantly better among operational than preoperational subjects. Ten to fourteen days later the differences were less pronounced. Memory for specific content elements of the jokes improved significantly from the first to second delay intervals. Recall was generally correlated with comprehension and expressive appreciation.

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CHAPTER I

Introduction

Overview

In recent years, humor has been studied from a cognitive developmental perspective. Those interested in explaining human behavior have long been intrigued by the complex and multifaceted nature of the humor response. Humor plays a role in such seemingly diverse areas as communications, play and adjustment to stress. Developmental research on humor has demonstrated that the types of humor children understand and appreciate change as a function of intellectual maturity (McGhee, 1971a). Several recent studies have examined the cognitive factors underlying humor development (McGhee, 1971a, 1971b, 1974, 1976; Brodzinsky and Rightmyer, 1980). However, little research has investigated how cognitive functioning mediates humor encoding and recall (Chapman and Crompton, 1978). The present study integrates the Piagetian theory of memory with research and theory on humor development in an attempt to explicate the relationships between cognitive functioning and humor comprehension, appreciation and memory. By understanding how children process cognitive humor, a more comprehensive view of humor development may emerge and new light may be shed on how humor processing reflects underlying cognitive organization.

Review of the Literature

The focus of the present study is on the development of children's responses to cognitive humor, with particular interest in children's memory for humor. The review of the literature will briefly discuss a fundamental similarity between major theories of humor before reporting relevant research on the cognitive basis for humor response. Following this portion of the review will be a summary of the literature on humor and memory. Finally, the Piagetian model of development will be applied to studying how cognitive humor is appreciated, comprehended and reconstructed as a function of cognitive competence.

Theories of humor. Although the prominent theories of humor differ in their explanations, they share the view that the humor response is elicited by perceived discrepencies and expectancy violations. Psychoanalytic proponents argue that humor is a savings in psychic energy brought about by the shift from a reality to fantasy mode of interpreting experience (Freud, 1916; Grotjahn, 1957). For children, humor is viewed as a means of mastering anxiety and coping with conflict (Kris, 1938; Wolfenstein, 1954; Levine, 1967). Gestalt theory posits that when an element in an integrated configuration is altered, the consequent change in focus elicits the humor response (Maier, 1932). Berlyne (1969) explains the physiological process involved in humor as based on abrupt shifts in arousal level resulting from the

effort and subsequent relief accompanying "making sense" of novel or incongruous stimuli. Cognitive developmental research has traced the humor response to discrepant stimuli from infancy well into childhood (McGhee, 1971a; Sroufe and Waters, 1976; Pien and Rothbart, 1980).

The major factors distinguishing the humor response from other reactions to incongruities are contextual and cognitive. Under certain conditions discrepancies and expectancy violations may elicit surprise, confusion or fear (Charlesworth, 1969; McGhee and Johnson, 1976; Pien and Rothbart, 1980). Incongruities are most likely to elicit humor when they are confronted in a "safe" setting (Rothbart, 1977), when there is a social facilitation (Chapman, Smith and Foot, 1980) and when deciphering the incongruity provides an optimal challenge (Kagan, 1971; Zigler, Levine and Gould, 1966, 1967; McGhee, 1976; Whitt and Prentice, 1977). It is the issue of cognitive challenge as a factor in humor response that has been of particular interest to developmental psychologists.

Humor and cognitive development. Developmental psychologists have long recognized a relationship between cognitive maturity and reaction to humor. Infants enjoy discrepant visual and motoric stimuli (Kagan, 1971; Sroufe and Waters, 1976; Pien and Rothbart, 1980) while older preschool children are amused by a variety of incongruities including socially inappropriate behavior (Kenderdine, 1931) and lin-

guistic absurdities (Groch, 1974). At approximately seven years old, children are found to become increasingly responsive to more intellectually challenging forms of humor such as jokes based on linguistic ambiguities and logical discrepancies (McGhee, 1971b; Schultz, 1972; Whitt and Prentice, 1977). Piagetian theory explains this shift in humor response as a result of the emergence of concrete operational thinking. Cognitive developmental research has paid particular attention to the changes in humor response which occur in children between six and eight years old because this is the age when logical schemes first become operative.

Underlying the cognitive developmental approach to studying humor is the premise that there are certain cognitive requisites necessary for the comprehension and appreciation of humor. To comprehend the point of a joke requires that the individual has the intellectual schemes necessary to form relevant cognitive expectations, and thereby be able to recognize the incongruities which arise when an expectation is contradicted. As McGhee (1971a) describes, "the child perceives expectancy violations as being funny only when he has acquired a stable enough grasp of the 'real world' that he can assimilate the disconfirmed expectancy as being only a play on reality." With the attainment of logical thinking, emerge more integrated and consistent expectancies. As equilibrium is achieved within

the concrete operational period, it can be expected that the nature of children's responses to cognitive humor will also change.

Within the cognitive developmental approach to studying humor, there has been a focus on matching the cognitive demands of the stimuli with the intellectual functioning of the individual (McGhee, 1976; Brodzinsky and Rightmeyer 1980). One way of highlighting the match has been to employ humorous stimuli based on intellectual points, in which affective themes have been minimized. It is recognized that social factors such as group allegiance (Chapman, Smith and Foot, 1980) and contextual variables such as the perceived safety of a setting (Pien and Rothbart, 1976) may be important factors affecting humor response. However, empirical research from a cognitive developmental perspective has attempted to reduce the influence of these variables in order to isolate and identify the cognitive basis for humor.

Empirical studies within the cognitive developmental framework have focused on the comprehension and appreciation of humor. Comprehension has generally been measured by analyzing the subject's recognition of the critical discrepancy underlying the stimulus (McGhee, 1974; Brodzinsky, 1975, 1977). Appreciation has been measured in two ways. Mirth, the spontaneous expression of enjoyment through smiling or laughing, has been recorded in much recent humor

research (Zigler, Levine and Gould, 1966, 1967; Shultz, 1972; McGhee, 1971b, 1976; Whitt and Prentice, 1977). In addition, subject ratings of jokes on a multilevel scale have provided a second measure of appreciation (Brodzinsky, 1975, 1977; McGhee, 1976; Whitt and Prentice, 1977).

Several studies have revealed relationships between the cognitive functioning of the individual and appreciation and comprehension of intellectually demanding humor. Brodzinsky and and his associates (Brodzinsky, 1976, 1977; Brodzinsky, Tew and Palkovitz, 1979), examining the relationship between conceptual tempo and humor response, found reflective children better able than impulsive children to unravel and identify the subtle incongruities embedded in ambiguity humor. When the basis of the humor was obvious, individual differences in problem solving behavior were not apparent. When the humor was based on subtle incongruities, reflective children were better able than impulsive children to identify the humorous basis for the jokes.

Shultz and his associates (Shultz, 1972, 1974; Shultz and Horibe, 1974) report that during the period between six and eight years old, children shift from appreciation of jokes presenting pure incongruities to appreciation of jokes in which incongruities are resolved. The authors speculate that operational thinking, which develops during this period, may contribute to increased appreciation for the more logically complete joke form.

Several recent studies of humor development have employed a Piagetian framework to investigate the contribution of operational thinking to humor response. McGhee (1971b) found that operational ability in seven year olds predicted comprehension of incongruity humor based on violations of logic. However, there were no differences between operational and preoperational subjects in their comprehension of novelty humor, based on purely visual and physical discrepencies.

Whitt and Prentice (1977) studied the influence of operational ability on response to a variety of riddle forms. They found that liquid conservation ability predicted comprehension and appreciation of riddles based on double meanings, but did not bear a relationship to response to three other riddle forms. The authors suggest that riddles based on double meanings required the decentering abilities associated with operational competence.

Research examining the relationship between cognitive ability and humor response has provided some support for the argument that intellectual maturity plays a role in the grasp and enjoyment of cognitive humor; however, the factors underlying this relationship need further explication. McGhee (1976) and Brodzinsky and Rightmyer (1980) have argued for greater specificity in studying the humor response. Rather than look at the contribution of specific abilities to general performance (McGhee, 1971; Whitt and Prentice,

1977) or general abilities to general performance (Shultz, 1972; Shultz and Horibe, 1974) they have argued for studies which match specific cognitive abilities with equally specifiable cognitive demands. It is suggested that only by creating such a match between subject and stimulus will the relationships between cognitive functioning and humor appreciation and comprehension be delineated.

Studies investigating the relationship between comprehension and appreciation as a function of cognitive maturity have found a curvilinear relationship between comprehension and appreciation (Zigler, Levine and Gould, 1966; 1967; McGhee, 1976). Zigler and his associates (1966) discovered that although comprehension increased steadily with age, mirth peaked among subjects for whom the stimuli were considered optimally challenging. They labeled this phenomenon the "cognitive congruency principle," and concluded that humorous stimuli which make "little cognitive demands are perceived as being less funny than those which are in keeping with the complexity of the child's cognitive apparatus." Humor which is no longer challenging is understood, but does not elicit the same enjoyment as humor which makes demands on the individual's intellectual abilities.

Zigler, Levine and Gould (1966; 1967) made a major contribution to the study of humor in developing the cognitive congruency principle. The theoretical basis for the cognitive congruency principle can be found in Berlyne's

arousal model of humor (1960; 1969). Berlyne (1960) states that "The joke, like the work of art, seems to have some optimal range of complexity. If it is too simple it is dismissed as childish or flat." The arousal boosts and jags, which Berlyne suggests underlie the humor response, are most marked when the humor is optimally challenging. The effort exerted for successful assimilation of the humor is greatest among those who have recently mastered a concept. Such effort is associated with high arousal levels. Subjects whose mastery of a concept is long established require less effort for successful assimilation and therefore experience minimal changes in arousal level. The lack of arousal results in low appreciation responses.

In their cognitive congruency studies, Zigler and his associates used age alone as an index of cognitive functioning and provided no independent gauge of stimulus complexity. McGhee (1971b) sought to provide a further test of their findings using operational level as a measure of intellectual maturity and presenting subjects with various types of novelty and incongruity humor. However, in this study McGhee (1971b) found no signficant relationship between humor appreciation and either comprehension or operational thinking.

In 1976, McGhee undertook a study which provided a closer match between cognitive functioning and humor complexity than did the original cognitive congruency studies

(Zigler, Levine and Gould, 1966, 1967) or his own study (1971b) by presenting humorous stimuli based on the violation of specific logical operations. McGhee (1976) presented the stimuli to subjects who had not yet attained competence in the targeted operation, to those who had recently attained operativity and those who had been operational in the targeted area for a relatively long period of time. Thus he was able to create conditions where the humor was either excessively, optimally or minimally challenging to a given subject. An example of a joke designed to violate the principle of mass conservation is "Mr. Jones went into a restaurant and ordered a whole pizza for dinner. When the waiter asked if he wanted it cut into six pieces or eight pieces, Mr. Jones said: 'Oh, you'd better make it six! I could never eat eight.'" In one experiment, McGhee (1976) used this joke and other jokes based on conservation themes to differentiate between humor responses in conservers and non-conservers.

In a second experiment, McGhee (1976) based the humor on class inclusion expectancy violations and studied the differential responses of children who had attained operativity in class inclusion and those who had not. In both experiments McGhee included older operational subjects, for whom the logical schemes were long established, as well as subjects who had recently attained operativity in the targeted area.

Both experiments (McGhee, 1976) supported the cognitive congruency principle in determining that funniness ratings were highest among subjects who had recently acquired competence in the targeted operation. Subjects who were operational in the designated area exhibited significantly higher comprehension and gave higher evaluative appreciation ratings than subjects who were preoperational. However, as predicted, there was a decrease in evaluative appreciation among older, operational subjects for whom the stimuli presented little challenge. Subjects who had recently acquired operativity in a targeted concept were the most likely to judge as humorous, jokes based on the violation of that concept. However, spontaneous appreciation was low among all groups and revealed no differences between operational and preoperational subjects.

Most cognitive developmental research on humor has focused on comprehension and appreciation. Although the Piagetian perspective has been used to examine appreciation and comprehension, it has not been extended to examine humor processing more fully to determine how humor is encoded and reconstructed. Yet, the same rationale which underlies the study of humor appreciation and comprehension can be extended to investigate the encoding and recall of cognitive humor.

Memory for jokes. According to the Piagetian framework, the memory for humor based on the violation of opera-

tional themes will be a function of a subject's acquisition of the operational schemes reflected in the humor. Cognitive developmental theory proposes that cognitive functioning mediates not only comprehension and appreciation but the memory process as well (Piaget & Inhelder, 1973). Piagetian theory and past research on humor development suggest a model which integrates memory for humor with humor appreciation and comprehension to provide a more comprehensive view of humor processing.

There are reasons for extending humor theory and research into the realm of memory for humor, besides the purely theoretical linkages suggested by the Piagetian paradigm. The memory process is fundamental to how children use humor in "real life" situations. It has been observed that the telling and retelling of jokes and riddles is an important aspect of social communication among elementary school children (Gardner, Winner, Bechofer and Wolf, 1978). The popularity of logical humor among elementary school children and the competence with which they recall favorite jokes is of interest to cognitive developmental psychologists. However, there is little research on how children encode and recall cognitive humor (Chapman and Crompton, 1978; Davies and Apter, 1980).

Most of the studies that have looked at the relationship between humor and memory have focused on the facilitating effects of humor on the retention of information

(Chapman and Crompton, 1978; Davies and Apter, 1980). These studies have aimed at answering the question of whether the use of humor in instruction, public speaking and advertising, contributes to memory for a message.

Results of memory facilitation studies have been inconclusive. While several studies indicate no benefit in using humor (Curran, 1973; Markiewicz, 1974; Cantor and Venus, 1980), others demonstrate that retention is enhanced through the use of humor (Hauck and Thomas, 1972; Kaplan and Pascoe, 1977; Chapman and Crompton, 1978; Davies, 1978).

Findings supporting the facilitating effects of humor on retention indicate that humor is most effective when the humor is directly related to the information to be remembered. For example, Kaplan and Pascoe (1977) found that after a six week delay, college students presented with humorous lectures exhibited better recall for concepts presented humorously than did students presented with serious lectures or with lectures in which the humor was unrelated to the main topic.

Studies that have focused on memory for the humor itself (i.e. riddle, joke, cartoon) are extremely sparse. Two studies comparing memory for jokes to memory for "serious" presentations indicate that jokes are remembered better than non-jokes (Dolinsky, 1978) and descriptive statements (Kintsch and Bates, 1977). Interpretation of these findings is based on the position that jokes are more likely

than non-jokes to be encoded because they receive greater attention due to their novelty.

There have also been some studies conducted on whether the perceived funniness of a joke bears a relationship to memory for the joke (Lee and Griffith, 1964; O'Connell and Peterson, 1964; Chapman, 1973). Findings indicate that jokes remembered best by adults are those which generate the most mirth and receive the highest appreciation ratings.

Studies examining memory for humor from a developmental perspective are rare. In one of the few studies including an assessment of memory for humor, Yasilove (1978) investigated developmental changes in explanations for different riddle types. Yasilove presented first, third, sixth and tenth graders with riddles of three difficulty levels: conceptual tricks, language ambiguities and absurdities. Developmental trends had previously been identified with the popularity of each of these riddle types (Yasilove, 1975). Comprehension followed the developmental sequence predicted. Memory for riddle answers, assessed after a one minute delay interval was generally high and increased with age.

The second development study of memory for humor also looked at riddle recall (Fowles and Glanz, 1977). The authors presented six to nine year olds with riddles based on linguistic ambiguities. Half of the subjects were reading on grade level and half were reading below grade level. After each riddle was presented, the subject was asked to

tell the riddle to a confederate. Subjects were later asked to explain the riddles. While on-grade-level reading appeared to predict riddle comprehension, recall did not predict comprehension. In certain cases recall exceeded comprehension. However, it should be noted that immediate recall was assessed without the use of distraction tasks. In addition, highest scores were given for verbatim recall. Both these conditions might tend to favor rote memory performance. Due to these factors and the fact that the sample comprised only fourteen subjects, it is necessary to be cautious about generalizing the findings.

Remembering and retelling jokes plays a significant role in the lives of elementary school children. Yet little is known about how children encode and decode humor. Among the questions which remain are what developmental differences exist in the way cognitive humor is remembered and how memory for humor is related to comprehension and appreciation.

The Piagetian framework, which has helped provide insight into how humor is understood and appreciated (McGhee, 1971a, 1971b, 1976), can be extended to explain how humor is remembered. McGhee's research is based on the cognitive developmental position that it requires a certain level of operational maturity to be able to understand and enjoy logical humor. Based on Piagetian theory it can be proposed that cognitive ability will also predict competent recall of

intellectual humor. Within the Piagetian framework, development differences in the logical basis of recall become the focus of attention.

Operative and figurative memory. Piaget distinguishes between two forms of memory (Piaget and Inhelder 1973). Operative memory, or memory in a broad sense, is directly linked to logical schemes of understanding. Operative memory is the memory for generalizations and meanings and is a function of the logical abilities of the individual. Piaget used the operations of seriation and horizontality of liquids in studying memory. In his seriation studies, Piaget (Piaget and Inhelder, 1973) presented each child with a seriated array of sticks and assessed whether children were able to reproduce the array after varying lengths of time. From his findings he argued that operational maturity determined how accurately a child was able to reconstruct the stimulus. Piaget performed similar experiments with horizontality of water level in an inclined decanter and judged a child's operative recall by the angle at which the child drew the water. In these and other memory studies, Piaget constructed stimuli with logical or conceptual components so that he could observe children's reconstructions and transformations of these stimuli over time.

Piaget defined figurative memory, or memory in the strict sense, as the memory for content derived from speci-

fic perceptions, localized in time and space. The shape of the decanter in the horizontality studies or the color of the sticks in the seriation studies would be considered figurative elements in the recall of each stimulus. While each is a part of the observer's perception of the particular stimulus, neither of the figurative components is central to the logical scheme underlying the stimulus. The distinction between figurative and operative memory, while uniquely Piagetian in its conceptualization, has a parallel in Tulving's distinction between semantic and episodic memory (see Brown, 1975).

The Piagetian model proposes that the individual transforms and distorts information in accordance with existing operative schemes. The intellectual competence of the child dictates how knowledge will be encoded and reproduced. The model has generated considerable research (see Liben, 1977a, 1977b). While much of this research has focused on the controversial phenomenon of long-term memory improvement, more germaine to the proposed study is the cross-sectional research on the relationship between cognitive maturity and memory performance. Most of the research in this area has used visual stimuli to assess the memory transformations made by children with different degrees of cognitive maturity.

Results have generally supported Piaget's position that cognitive level predicts accuracy of operative recall

(Liben, 1974; Crowley, 1975; Trapanier and Liben, 1979). Accuracy of figurative recall, however, does not appear to bear a relationship to cognitive competence, as assessed through cognitive tasks (Liben, 1977a, 1977b). One aspect of the present study is to look at how memory reflects cognitive organization with regard to both figurative and operative functioning.

CHAPTER II

Statement of the Problem

The present study applies the Piagetian model of memory to the area of humor. The focus of the study is on extending cognitive developmental theory and research to investigate how memory for humor develops as a function of cognitive competence. The relationship between cognitive ability and humor comprehension, appreciation and memory is the focus of the present study.

Cognitive developmental research has undertaken the challenge of applying Piagetian theory to the multi-dimensional area of humor response. The basis of humor is generally considered to be the violation of expectations (see McGhee, 1974). Piagetian theory posits that cognitive expectations are a reflection of intellectual schemes, which become increasingly complex and integrated during the concrete operational period of development. Cognitive developmental investigators have demonstrated that as logical schemes emerge, subjects respond to the violation of logical premises with increased appreciation (McGhee, 1976). The understanding that a logical principle has been violated is apparent only among those who have already developed operational competence in a targeted area. Those who have not yet attained operativity in the targeted area find humor

sufficiently consistent with their preoperational schemes that they fail to recognize that a logical principle has violated. They neither comprehend nor appreciate the discrepancy underlying the humor. Those subjects who have recently become operational in a particular area indicate the greatest appreciation ratings for humor based on newly attained concepts.

The Piagetian model of memory posits that the intellectual competence of the child determines how information is organized in memory (Piaget and Inhelder, 1973). The individual transforms experience in keeping with existing schemes of understanding. Piaget identifies two forms of memory. Operative recall reflects the cognitive organization of the individual which inextricably links memory to intelligence. Figurative recall, also mediated by cognitive functioning, is tied to perception and specific content elements of the stimuli.

Cognitive developmental psychologists interested in humor (McGhee, 1976; Brodzinsky and Rightmyer, 1980) and in memory (Liben, 1977) have called for empirical research which matches the cognitive functioning of the individual with the cognitive demands of the stimuli. McGhee (1976) contends that humor stimuli should be used "in which comprehension of the point of the intended humor depends on the utilization of specific measurable concepts or abilities. Furthermore, there must be some independent basis for predicting in

advance how much effort will be required for successful assimilation of the stimulus content into existing cognitive structures." The present study provides such a match between cognitive functioning and stimulus demands on two different cognitive operations: class inclusion and weight conservation.

In the present investigation, subjects were selected and assigned to experimental groups on the basis of their attainment of operativity in class inclusion and weight conservation. Class inclusion skills are generally acquired between the ages of seven and eight (Inhelder, Sinclair and Bovet, 1974) and weight conservation skills are generally in evidence between eight and nine (Elkind, 1961; Inhelder, Sinclair and Bovet, 1974). The sample comprised subjects age 6.0 to 9.0 who were preoperational in class inclusion and weight conservation; had attained operativity in class inclusion but not in weight conservation; were operational in both class inclusion and weight conservation. It was assumed that subjects who were operational in weight conservation and/or class inclusion had attained their competence in these areas relatively recently, since the majority of children achieve competence in these operations while in the 6.0 to 9.0 age range. In addition to the "relatively recent" class includers and weight conservers, a group of class includers and weight conservers age 10.0 to 12.0 was included in the study. It was assumed that these "older"

operational subjects had achieved operational competence in both areas at least one year prior to the study.

Following the cognitive preassessment in class inclusion and weight conservation, subjects were presented with twelve stimulus items including four humorous stories which violated the principle of class inclusion, and four humorous stories which violated the principle of weight conservation. Some of the humorous items which were employed were developed and tested by McGhee (1976) and others are adaptations of his jokes. In each case the violation of a logical expectation (class inclusion or weight conservation) was the "point" of the humor. The remaining four stimulus items were similar to the humorous items in all respects, except that they did not present expectancy violations and were therefore designated "non-humorous" items.

After each story was presented on a tape recording, the subject's appreciation response was measured in two ways. The subject's expressive appreciation or mirth was rated by the experimenter, and the subject was asked to indicate an evaluative appreciation response on a rating scale. After a five minute delay interval, subjects were presented with picture cues depicting features of the humorous stimulus stories. Subjects were asked to retell the stories from memory. Following the recall task, subjects were represented with the humorous stimulus stories and administered a comprehension task in which they were asked

to explain the humorous basis for each story. Picture cues were presented to subjects again after a ten to fourteen day delay interval and subjects were again asked to retell the stories from memory.

The reason for using a five minute delay interval was that Piaget and Inhelder (1973) postulate that transformations in memory occur "as soon as the model is removed from sight . . . as soon as perception ceases to act as a restraint." However, empirical studies of memory within a Piagetian framework have found that memory after relatively brief delay intervals (one hour, one day) often evidences strong figurative control (Liben, 1977). That is to say, figurative recall appears to facilitate the preoperational child's memory performance after brief delay intervals. The five minute delay interval was selected for use in the present study because: 1) it provided a sufficient time lapse from initial presentation for operative memory to begin to exert control, thereby providing a test for the hypotheses that subjects who were operational in a given area would exhibit better operative recall than those who were preoperational, 2) it represented a brief enough time lapse to ensure that sufficient amounts of recall data could be generated by subjects to test the hypotheses regarding decreased figurative recall over time.

The ten to fourteen day delay interval was selected because it allowed sufficient time for deterioration of

figurative memory to occur, while ensuring that subjects remained on the same operational levels in class inclusion and weight conservation as demonstrated on the cognitive preassessment. Since preoperational subjects' operative recall after the five minute delay interval was expected to be artificially inflated due to strong figurative control, it was thought necessary to measure recall after the figurative influence had declined.

It was expected that humor processing would reflect the cognitive functioning of the child. Attainment of mastery in a particular operation would predict comprehension of humor based on that operation. It was also predicted that appreciation of cognitive humor would be greatest among the individuals in the 6.0 to 9.0 age range who were operational in the area targeted by the humor. The "cognitive congruency principle" (Zigler, Levine and Gould, 1966, 1967; McGhee, 1976) contends that humor is appreciated most when it is optimally challenging. Preoperational subjects and older (10.0 to 12.0 year old) operational subjects for whom the humor was excessively and minimally challenging respectively were expected to demonstrate lower appreciation scores than "recent" operational subjects. Comprehension was expected to be a function of cognitive competence in the targeted operation. Class includers were expected to comprehend the humorous point of stories which violated class inclusion expectations; weight conservers were expected to

comprehend the humorous point of stories which violated weight conservation expectations.

It was also expected that the quality of memory, the ability to maintain the integrity of the humor, would be a function of cognitive ability. Operative memory for the humor would be reflected in intact reproduction of the logical incongruity. Figurative memory, on the other hand, would be reflected in the recall of specific content elements. In the cognitive jokes used, the figurative and operational elements would be relatively independent of one another. In other words, it would be possible for a subject to recount a large percentage of the figurative elements of specific contents and nevertheless fail to relate the critical incongruity upon which the humor was based. Conversely, it would be possible for a subject to retain the structure and point of the humor in retelling while substituting inaccurate figurative elements.

Thus, reproductions of the humor could be wholly accurate or represent figurative and/or operative distortions. When the figurative elements alone are transformed, the integrity of the humor is retained. When the operative basis of the humor is distorted, the humor loses its meaning.

Piagetian theory and empirical research in the areas of humor and memory support an integrated view of humor processing which addresses not only how humor is understood and enjoyed but also how it is encoded and recalled. The

Piagetian model provided the framework within which to investigate the cognitive factors affecting humor response in an attempt to create a more coherent view of humor processing.

Measures

Before presenting the hypotheses there will be a brief description of the dependent measures employed in the present study. More detailed descriptions of the tasks and measures can be found in the method section.

Expressive appreciation or mirth measures the subject's spontaneous expression of enjoyment through smiling or laughing. A score of 4 to 16 may be obtained by each subject for each of the stimulus types: class inclusion stores, weight conservation stories and non-humorous stories.

Evaluative appreciation measures the subject's rating of the "funniness" of each stimulus item. A score from 4 to 16 may be obtained by each subject for each of the stimulus types: class inclusion stories, weight conservation stories and non-humorous stories.

Comprehension measures the subject's identification of the "point" of the humor. A score from 4 to 20 may be obtained by each subject for each of two stimulus types: class inclusion stories and weight conservation stories.

Operative recall measures the inclusion of the operational expectancy violation in the subject's retelling of the stimulus story. A score from 0 to 4 may be obtained for

each of two stimulus types: class inclusion stories and weight conservation stories.

Figurative recall measures the inclusion of specific content elements in the subject's retelling of the stimulus story. A score from 0 to 25 may be obtained by each subject on the class inclusion stories and from 0 to 25 on the weight conservation stories.

Hypotheses

1. Class includers will demonstrate significantly higher comprehension scores for class inclusion jokes than will non-includers.

2. Conservers of weight will demonstrate significantly higher comprehension scores for weight conservation jokes than will non-conservers of weight.

3. Recent class includers (6.0 to 9.0 years old) will demonstrate significantly higher appreciation scores for class inclusion jokes than will non-includers and older class includers (11.0 to 12.0 years old).

4. Recent conservers of weight (6.0 to 9.0 years old) will demonstrate significantly higher appreciation scores for weight conservation jokes than will non-conservers of weight and older weight conservers (10.0 to 12.0 years old).

5. Recent class includers (6.0 to 9.0 years old) will demonstrate significantly higher appreciation scores for class inclusion jokes than they will for non-humorous stimulus items.

6. Recent weight conservers (6.0 to 9.0) will demonstrate significantly higher appreciation scores for weight

conservation jokes than they will for non-humorous stimulus items.

7. Class includers will demonstrate significantly higher operative recall scores for class inclusion jokes than will non-includers after a five minute delay interval and after a ten to fourteen day delay interval.

8. Weight conservers will demonstrate significantly higher operative recall scores for weight conservation jokes than will non-conservers of weight after a five minute delay interval and after a ten to fourteen day delay interval.

9. Non-includers and class includers will demonstrate significantly higher figurative recall scores for class inclusion jokes after a five minute delay interval than they will after a ten to fourteen day delay interval.

10. Non-conservers of weight and conservers of weight will demonstrate significantly higher figurative recall scores for weight conservation jokes after a five minute delay interval than they will after a ten to fourteen day delay interval.

CHAPTER III

Method

Subjects

The subjects were 80 children, 38 girls and 42 boys, selected for the study on the basis of performance on class inclusion and weight conservation preassessment tasks. The sample comprised 60 children between the ages of 6.0 and 9.0 and 20 children between the ages of 10.2 and 11.9. Group I was composed of 20 children who were preoperational in both class inclusion and weight conservation. These subjects ranged in age from 6.3 to 8.7 ($\bar{x}$ = 7.3, s.d. = .79). Group II comprised 20 children who were operational in class inclusion and preoperational in weight conservation. This group ranged in age from 6.6 to 8.9 ($\bar{x}$ = 7.6, s.d. = .78). Group III comprised 20 children who were operational in both class inclusion and weight conservation. This group ranged in age from 6.0 to 8.9 ($\bar{x}$ = 7.8, s.d. = .52). Group IV was also composed of 20 children who were operational in both class inclusion and weight conservation. However, their age range was 10.2 to 11.9 ($\bar{x}$ = 11.1, s.d. = .52). Subjects were drawn from two predominantly middle class elementary schools in New York City.

Materials

Cognitive assessment. The materials used to assess class inclusion skill were ten plastic beads, including eight brown beads and two yellow beads. Playdoh of two different colors was used to assess weight conservation ability.

Stimulus materials. The humor materials employed in the study included eight humorous stories and four non-humorous stories. Four of the humorous stories were based on the violation of class inclusion principles. The other four humorous stories were based on the violation of weight conservation principles. Several of the humorous stories were adaptations of jokes created by McGhee (1976). Vocabulary used in the stories included only words generally understood by first grade children. Humorous stories based on class inclusion can be found in Table 1 and humorous stories based on weight conservation can be found in Table 2. Non-humorous stories can be found in Table 3.

One picture was used to cue each humorous story in the recall task. Each of the eight picture cues depicted a feature of the related story. The picture cues, presented in 5"x5" cards, were color drawings. Pilot testing of the materials indicated that children are able to recognize the content of the drawings. Tables 1 and 2 describe picture cues for class inclusion and weight conservation stories.

Table 1

Humorous Stories Based on Class Inclusion

1. A boy went to the zoo one morning. When he came home his father asked "did you see any animals in the zoo?" "No, I didn't see any animals," said the boy, "but I saw a giraffe."
   Picture cue: giraffe

2. A girl was getting everything ready for a birthday party so she asked her little sister to play outside the house. "Okay," said the little sister, "if I can't play in the house, then I'll play in my room."
   Picture cue: girl playing with toys in room.

3. A woman told her friend "I didn't like the restaurant I went to last week. I asked for a piece of fruit and they brought me an apple instead."
   Picture cue: apple

4. A teacher asked his class "How many children were born in America?" When one of the children didn't raise his hand, the teacher asked, "Weren't you born in America?" "Not me," said the boy, "I was born in a New York hospital."
   Picture cue: teacher and students in class

Table 2

Humorous Stories Based on Weight Conservation

1. Two boys were in a boat in the middle of a lake. They brought a big bottle of orange juice with them in the boat. One boy drank the juice. The other one said, "Now you're so heavy we'll sink."
   Picture cue: boat in water

2. A grandmother was in the park with a baby. A girl asked "How much does the baby weigh?" "I don't know his weight," said the grandmother, "but I know he weighs a little less when he's sleeping."
   Picture cue: baby

3. A boy went shopping for his family. "I'm not strong enough to carry this big bag of food," said the boy. The woman in the store said, "Okay, I'll put the eggs on top and the cans on the bottom to make the bag lighter."
   Picture cue: bag of groceries

4. A man went to the doctor. The doctor weighed the man and said, "I see you put on a few pounds." "Oh no I didn't," said the man, "I'm just not standing up straight."
   Picture cue: doctor

Table 3

Non-humorous Stories

1. Two girls were walking in the rain under an umbrella. When the rain stopped one girl said, "We don't need this umbrella anymore."

2. A family went to the beach in their car. They got to the beach and the father said, "We can have our picnic soon. Let's take the food out of the car."

3. A boy wanted to ride his friends bicycle. His friend said, "Alright, just be sure you bring it back this afternoon. I'll need it then."

4. A girl said to her mother, "I'm going for a walk." Her mother said, "It's cold out - you'd better wear a sweater." "Okay," said the girl. She put on her sweater.

Distraction materials. Two games were offered to subjects to play with during the five minute interval between the presentation of the tape recorded stimulus materials and the first recall task.

The games were: the Whippit by IJN, a color cube matching game; and Wee Wonderful Waterfall by Tomy, a game in which the player presses a button to control placement of hoops in a cup-size sealed water container.

Pilot testing had determined that both games were of interest to children in the 6.0 to 12.0 age range, and could hold their attention for the delay interval.

Procedure

Each subject was tested individually by the experimenter. The cognitive assessment tasks preceded the humor tasks.

Cognitive assessment tasks. The operational abilities of subjects were assessed in class inclusion and weight conservation. The order in which the two tasks were presented was counterbalanced within each experimental group.

Class inclusion ability was assessed using the procedure developed by Piaget (1928). The ten beads were placed in front of the child and the experimenter explained that there are ten plastic beads, eight brown plastic beads and two yellow plastic beads. The child was then asked 1) "How many plastic beads are there?" 2) "How many brown beads are there?" 3) "How many yellow beads are there?"

4) "Are there more plastic beads or more brown beads?" Subjects were asked to explain their judgement. A class inclusion explanation was a statement which identified the plastic beads as belonging to the superordinate class. Subjects were designated class includers if they gave correct responses to the fourth question, provided a class inclusion explanation of their judgment, and did not waiver in their judgment when presented with the counter-argument. Subjects who said that there were more brown beads than yellow beads were classified as pre-operational in class inclusion ability.

Weight conservation ability was assessed using an adaptation of Elkind's (1961) replication of Piaget's procedures. Playdoh in two different colors was presented to the subject. The subject was asked, "Do these balls of playdoh weight the same? You can pick them up to find out." If the subject said they did not weigh the same the experimenter said "Make them the same." When the subject agreed that the two balls were of equal weight the experimenter flattened one of the balls into a pancake while the subject watched. The experimenter asked, "Do the ball and the pancake weigh the same, do they have the same amount of weight?" (Judgment question.) The subject was then asked, "Why is that?" by the experimenter. (Explanation question.) A conservation explanation was one which stated that the weights were invariant.

The experimenter also presented a counter-argument to conservers. Those giving conserving responses were told, "One boy (or girl) told me that the pancake weighs more than the ball." Subjects who presented consistent conservation responses to the judgment, explanation and counter-argument were classified as weight conservers. Subjects who did not present conservation responses on the judgment and explanation were classified as preoperational for weight conservation.

Humor tasks. The eight humorous stories and four non-humorous stories were presented to subjects on a tape recording. The recording alternated between class inclusion jokes, weight conservation jokes and non-humorous stories. Two different, counterbalanced, orders of presentation were recorded. Assignment to an order of presentation was counterbalanced to ensure that an equal number of subjects in each experimental group would hear each of the two orders.

Each subject was interviewed individually. Each subject was told by the experimenter, "I'm trying to find out what stories people find funny. People find different things funny. I have some new stories and I want to find out if you think they are funny. I'm going to play the stories on a tape recorder. After you hear each story, I'd like you to show me which face goes best with that story." The experimenter presented a four-point funniness scale

comprised of four faces ranging in expression from no smile to a broad smile. "If you find the story not funny at all, point to this face," (the experimenter indicated the face with no smile), "If you find the story a little funny, point to this face," (experimenter indicated face with slight smile), "If you find the story pretty funny, point to this face," (experimenter indicated face with moderate smile), "and if you find the story very funny, point to this face," (experimenter indicated face with broad smile).

The experimenter then checked to ascertain that the subject had understood the scale by asking "Which face will you point to if you find a story pretty funny?", "Which face will you point to if you find a story a little funny?", "Which face will you point to if you find a story very funny?" and "Which face will you point to if you find the story not funny at all?" If the subject correctly identified each of the faces the experimenter proceeded. If the subject identified a face incorrectly, the experimenter corrected the subject by saying "If the story is (appropriate item) point to this face," and indicated the corresponding face. Before proceeding to the tape presentation, the experimenter returned to the item in question to ascertain that the subject had mastered the funniness scale.

The experimenter played the tape recording of the twelve stories. There was a ten second pause between stories, during which the experimenter said "Show me the

face that goes with that story." The experimenter recorded the subject's judgment. 1 = not funny at all (face with no smile); 2 = a little funny (face with slight smile); 3 = pretty funny (face with moderate smile); 4 = very funny (face with broad smile). This measure of evaluating appreciation has been used by Brodzinsky and others (see Brodzinsky 1980). For each subject the evaluative appreciation score could range from 1 to 4 for each item and therefore from 4 to 16 for each class of stimuli.

Immediately after presentation of each story, the experimenter recorded the subject's spontaneous response to that story on an expressive appreciation scale. Operationally defined, expressive appreciation or mirth is a measure of the spontaneous smiling and laughing exhibited by a subject. The expressive appreciation scale (Brodzinsky 1979) consists of four points: 1 = blank expression, 2 = slight smile, 3 = full smile, 4 = laughter. For each subject the expressive appreciation score may range from 4 to 16 for each stimulus type. The experimenter achieved a reliability score of 81% with an independent rater using eight pilot subjects before and during the data collection period. Each pilot subject was presented with two class inclusion jokes, two weight conservation jokes and two non-humorous items. Reliability was calculated by dividing the total number of items (48) into the number of agreements (39) to obtain a percentage.

After all twelve stories were presented, the experimenter said, "Let's do something different as a change." The experimenter offered the subject two games to play with while she looked over her papers. The games served as a distraction task, intervening between the humor presentation and the memory task to inhibit rehearsal. Each subject played with one or both of the games for five minutes before the experimenter indicated that it was time to put them away.

After the five minutes had elapsed the experimenter said, "I'm going to show you some pictures. One picture goes with each of the stories you just heard. I'm going to put the pictures on this table. If a picture makes you think of one of the stories, pick up the picture and tell that story. Pretend you're telling the story to a friend. I'm going to turn on this tape recorder while you're telling the stories."

The experimenter placed the picture cue cards on a table, rotating the order between subjects. If there was a pause of over ten seconds after a story was related, the experimenter said, "Do any of the other pictures make you think of a story you just heard?" If the subject answered in the affirmative but did not retell another story, the experimenter waited an additional thirty seconds before asking "Can you tell any of the other stories?" If the subject either said "no" or said "yes" and then did not

respond for an additional ten seconds the experimenter said, "Let's go on to something else now."

Memory responses were transcribed and coded from the tape recording for both operative and figurative recall. The criterion for identifying an operative recall response was the inclusion of the central expectancy violation in the response.

Operative recall was based on a two point scale;

0 = recall did not reflect violation of the targeted operation,

1 = recall reflected the violation of the targeted operation.

Operative recall scores ranged from 0 to 4 on each of the two stimulus types: class inclusion and weight conservation. Responses were scored blindly and reliability was attained by assessing agreement between the experimenter and an independent judge for 20 randomly selected transcribed protocols, half from the first delay interval and half from the second. Reliability of 94% was obtained by dividing the number of agreements (150) by the number of items (160).

An example of a 0 rated response is, "A boy went to the zoo. He came home and his father asked him if he had seen any animals in the zoo. The boy said he'd seen a giraffe and lots of other animals too." An example of a 1 rated response is, "A girl went to the circus. Her brother wanted to know what she'd seen. The girl said she saw a giraffe,

but not any animals."

Figurative recall was a measure of the number of specific elements included in a response. Figurative recall was based on a content analysis. Each story was divided into several content units. Figurative recall was assessed by the total number of content units presented in the subject's retelling of the story. The measure is an adaptation of Flavell's (1968) procedure. Tables 4 and 5 present the figurative elements found in each of the humorous stories. For class inclusion stories, figurative recall ranges from 0 to 25. For weight conservation stories the range is 0 to 25. Responses were scored blindly and reliability was attained by assessing agreement between the experimenter and an independent judge on a random sample of eight transcribed protocols. Reliability of 99% was obtained by dividing the number of agreements (199) by the number of content units coded (200).

After the memory task had been completed, the experimenter administered a comprehension task. The experimenter said, "Now I'm going to play back the stories you heard before. I want to find out what you think about them. People find different things funny. If you found the story funny, please tell me why you think it was funny. If you didn't find the story funny, tell me why some other people might think it's funny." If the subject did not explain the story, the prompt question "Why does that make it funny?" was asked.

Table 4

Figurative Elements in Humorous Stories

Based on Class Inclusion

1. boy, zoo, morning, father, animals, giraffe
2. girl, birthday party, little sister, play, house, room
3. woman, friend, restaurant, last week, piece of fruit, apple.
4. teacher, class, children, American, born, New York, hospital

Table 5

Figurative Elements in Humorous Stories

Based on Weight Conservation

1. boys, boat, lake, bottle, orange juice, sink
2. grandmother, park, baby, girl, less, sleeping
3. boy, shopping, family, strong, food, woman, store eggs, cans
4. man, doctor, few pounds, standing up straight

The comprehension task measured the subject's identification and resolution of the critical incongruity. To assess humor comprehension, the following five-point scale was used (Brodzinsky 1977). 1 = subject made no attempt to explain the humor, or stated that nothing was funny about the joke; 2 = subject mentioned different aspects of the joke but did not relate to any form of incongruity; 3 = subject described and/or resolved a noncritical or idiosyncratic incongruity of the joke; 4 = subject noted the critical incongruity but was unable to resolve it; 5 = subject noted the critical incongruity and was able to resolve it. The range of possible scores was 4 to 20 for class inclusion stories and 4 to 20 for weight conservation stories. The experimenter and an independent judge assessed reliability on a random sample of 19 comprehension protocols. The number of responses (152) divided into the number of agreements (129) yielded a reliability score of 85%. Comprehension responses were scored blindly by the experimenter.

Example Responses:

		Rating
I don't know why that was so funny. It just was.	=	1
It was funny 'cause the boy went to the zoo. He saw a giraffe.	=	2
It was funny because giraffes have long necks.	=	3
It was funny because the boy said he didn't see any animals but he saw a giraffe.	=	4
It was funny 'cause the boy said he didn't see any animals, just a giraffe. A giraffe is an animal.	=	5

Each subject was thanked for his or her participation and asked not to tell the stories to other children since that might take away from their enjoyment and surprise. The experimenter did not indicate to the subject that she would return for another interview.

After a delay interval of ten to fourteen days the experimenter again administered the recall measure, but not the appreciation and comprehension measures to each subject.

The experimenter said, "When I was here before you heard some stories and looked at pictures that went with the stories. I want to find out if you remember the stories." The remainder of the interview protocol was identical to the protocol employed after the five minute delay interval including the same timing and prompt questions. As with the five minute delay interval, responses were tape recorded and later scored blindly for figurative and operative recall. While a range of ten to fourteen days was selected for the delay interval to reduce attrition, an attempt was made to achieve comparable mean delay intervals between groups.

CHAPTER IV

Results

Design

The study was designed to create a match between cognitive functioning and stimulus demands, in an attempt to provide data which would explicate the relationships between underlying cognitive competence and humor response. The matching of cognitive functioning and stimulus demands was accomplished by forming experimental groups differentiated by their cognitive competence in specific Piagetian operations and collecting data regarding the humor response of subjects in these groups to stimuli based on the corresponding Piagetian operations. The study was designed not only to compare performance of subjects at different operational levels, but also to compare performance of subjects within an operational level across tasks, and over time.

The basic experimental design of the study was a two factor repeated measures analysis of variance with operational level as one factor and task type as the second factor. Data were collected for seven dependent variables reflecting humor response; comprehension, expressive appreciation, evaluative appreciation, operative recall after a five minute delay interval, figurative recall after a five minute delay interval, operative recall after a ten

to fourteen day delay interval and figurative recall after a ten to fourteen day delay interval.

The grouping factor reflected four distinct levels of operational competence. Groups I, II and III were each composed of 20 subjects in the 6.0 to 9.0 age range. However, each of the three groups reflected a different level of operational competence, as determined by preassessment tasks administered in class inclusion and weight conservation. Group I subjects were not operational in either class inclusion nor weight conservation. Group II subjects were operational in class inclusion but were preoperational in weight conservation. Group III subjects were operational in both class inclusion and weight conservation. Group IV subjects were distinguished from Group III subjects by age rather than operational level. Group IV comprised 20 subjects in the 10.0 to 12.0 age range who were determined to be operational in both class inclusion and weight conservation and, because of their greater age, were assumed to have mastered the operations less recently than subjects in the 6.0 to 9.0 range.

The hypotheses were formed to provide specific contrasts between individual groups on particular task types. Therefore a priori comparisons (also known as planned comparisons) were conducted to test most of the hypotheses. The specificity of the design and the hypotheses made it possible to use this statistically

powerful form of analysis.

For comprehension, expressive appreciation and evaluative appreciation the task type was composed of two levels; one for humorous class inclusion stimuli and one for humorous weight conservation stimuli. Analyses for comprehension, expressive and evaluative appreciation each represent a 4x2 repeated measure design. For the two dependent variables of expressive appreciation and evaluative appreciation, a third task type comprising non-humorous stimuli was included in repeated-measure two-tailed t-tests to compare responses to humorous and non-humorous items.

The operative and figurative recall measures represent a more complex design because for these two dependent variables data for class inclusion and weight conservation stimuli were collected at two distinct intervals. Therefore, designs for recall measures represent 4x2x2 analyses of variance with four levels of the grouping factor, two levels of task type (class inclusion and weight conservation) and two levels of delay interval (five minutes and ten to fourteen days).

Analysis

The results of the data analyses are presented by dependent variable, with comprehension, appreciation, and recall representing the three main categories of dependent variables.

The result of the test of each hypothesis is included in the section corresponding to the dependent variable tested in that hypothesis. The hypotheses focused on specific contrasts between scores of subjects at given operational levels on particular stimuli. These contrasts were conducted using a priori comparisons. Repeated-measure two-tailed t-tests wre also used to test certain hypotheses involving appreciation responses. The repeated measure analyses of variance were conducted to provide a context within which to interpret the hypotheses tested and suggest areas for future research.

Comprehension

Comprehension for each class inclusion and weight conservation joke was assessed using a 1 to 5 point scale. Comprehension scores for class inclusion and weight conservation items indicated that within each task type, comprehension generally increased with cognitive maturity. The means and standard deviations for comprehension scores are shown on Table 6.

Class Inclusion. It was hypothesized that class includers would demonstrate significantly higher comprehension scores for class inclusion jokes than would non-includers. To test this hypothesis, a priori comparisons were conducted contrasting comprehension scores of class includers and non-includers on class inclusion items. The hypothesis was

Table 6

Means and Standard Deviations for Comprehension Scores On Class Inclusion and Weight Conservation Jokes

	Humor Type			
	Class Inclusion		Weight Conservation	
Level	M	SD	M	SD
I	3.44	.83	2.99	.68
II	4.00	.75	2.94	.92
III	4.40	.74	3.55	.80
IV	4.69	.52	4.36	.66

Note: Maximum score 5 on class inclusion items; 5 on weight conservation items.

supported. Group II subjects (operational in class inclusion but preoperational in weight conservation) demonstrated significantly higher comprehension scores than Group I subjects (preoperational in both class inclusion and weight conservation), $F(1,76)=6.11$, $p < .05$. Group III subjects (operational in both class inclusion and weight conservtion) also demonstrated significantly higher comprehension scores than did Group I subjects, $F(1,76)=17.88$, $p<.01$.

Weight Conservation. Also tested with a priori comparison was the hypothesis that conservers of weight would demonstrate significantly higher comprehension scores for weight conservation jokes than would non-conservers. The hypothesis was supported by the finding that Group III subjects (operational in both areas) had significantly higher weight comprehension scores than Group II subjects (operational in class inclusion but not in weight conservation), $F(1,76)=6.47$, $p < .05$; and than Group I subjects (preoperational in both areas), $F(1,76)=5.46$, $p < .05$. Thus, subjects who were operational in weight conservation had greater comprehension for items based on this operation than their same-age peers who were preoperational in weight conservation.

Further analyses. A 4x2 (operational group x humor type) repeated measures analysis of variance was performed to gain a more comprehensive view of comprehension for class

inclusion and weight conservation jokes. Significant main effects were found for group $F(1,76)=16.54$, $p < .01$ and for treatment $F(1,76)=63.83$, $p < .01$. A significant interaction effect between group and humor type was also found, $F(1,76)=4.17$, $p < .01$.

Scheffe post hoc comparisons performed on the interaction indicated a difference between weight conservation and class inclusion comprehension scores in Groups II and IV at the $p < .05$ level. In Group II there was a significant disparity between comprehension scores for humor based on class inclusion and on weight conservation. Group II subjects demonstrated greater comprehension for class inclusion than weight conservation items ($\bar{x} = 4.00$ for class inclusion; $\bar{x} = 2.94$ for weight conservation). In Group IV, comprehension for jokes based on the two different operations was more comparable ($\bar{x} = 4.69$ for class inclusion; $\bar{x} = 4.36$ for weight conservation).

Appreciation

Two types of appreciation, evaluative and expressive appreciation, were both assessed in the present study. Evaluative appreciation was based on a 1 to 4 rating system in which subjects judged the relative "funniness" of items presented. Expressive appreciation was based on the experimenter's judgment of the amount of mirth exhibited by subjects, on a 1 to 4 scale. The results of each type of

appreciation measure will be reported separately in the results section and compared in the discussion section. Expressive and evaluative appreciation responses were recorded for four non-humorous items as well as the humorous class inclusion and humorous weight conservation items. The non-humorous items, which resembled the humorous items in tone and number of words, were used as control items. Means and standard deviations for expressive appreciation scores on class inclusion, weight conservation, and non-humorous items are shown in Table 7. Table 8 presents means and standard deviations for evaluative appreciation scores on class inclusion, weight conservation, and non-humorous items.

Expressive Appreciation

Class inclusion. One hypothesis tested with regard to expressive appreciation for class inclusion jokes was that recent class includers (Groups II and III) would demonstrate significantly higher appreciation scores than would non-includers and older class includers (Group IV). This hypothesis was partially supported. A priori comparisons indicated that subjects in Group III attained significantly higher expressive appreciation scores on class inclusion jokes than did subjects in Group I, $F(=1,76)=9.99$, $p<.01$. However, there were no significant differences in expressive appreciation scores for class inclusion jokes between subjects in Group II (who were class includers but not weight

Table 7

Means and Standard Deviations for Expressive Appreciation Scores on Class Inclusion Jokes, Weight Conservation Jokes and Non-humorous Items

	Humor Type					
	Class Inclusion		Weight Conservation		Non-humorous	
Level	M	SD	M	SD	M	SD
I	1.98	.73	1.86	.56	1.38	.37
II	2.32	.85	2.17	.69	1.32	.39
III	2.70	.70	2.35	.56	1.17	.27
IV	1.99	.59	1.91	.43	1.25	.62

Note: Maximum score 4 on class inclusion items; 4 on weight conservation items; 4 on non-humorous items.

Table 8

Means and Standard Deviations for Evaluative Appreciation Scores on Class Inclusion Jokes, Weight Conversion Jokes and Non-Humorous Items

	Humor Type					
	Class Inclusion		Weight Conservation		Non-humorous	
Level	M	SD	M	SD	M	SD
I	2.67	.76	2.74	.77	2.16	.75
II	2.65	.68	2.62	.60	1.65	.70
III	2.81	.77	2.48	.92	1.39	.45
IV	1.97	.63	1.81	.59	1.07	.18

Note: Maximum score 4 on class inclusion items; 4 on weight conservation items; 4 on non-humorous items.

conservers) and subjects in Group I (who were neither class includers nor weight conservers).

It was expected that recent class includers (Group II and Group III subjects) would demonstrate significantly higher expressive appreciation for class inclusion jokes than would Group IV subjects, who had been class includers for a longer time. It was found, as predicted, that Group III subjects demonstrated significantly greater expressive appreciation for class inclusion than did Group IV subjects, $F(1,76)=9.64$, $p< .01$. However, Group II and Group IV subject scores were not significantly different.

A priori comparisons of expressive appreciation scores on class inclusion jokes support the hypothesized differences with regard to Group III subjects. These subjects, operational in both class inclusion and weight conservation, demonstrated significantly greater expressive appreciation of class inclusion jokes than did subjects who were pre-operational in class inclusion and than Group IV subjects whose mastery was longer established. While Group II subjects demonstrated greater expressive appreciation than did Group I or Group IV subjects, the differences were not statistically significant.

It was also hypothesized in the present study that recent class includers (Groups II and III) would demonstrate significantly higher expressive appreciation scores for class inclusion jokes than they would for non-humorous

items. To test this hypothesis, repeated-measures two-tailed t-tests were conducted to assess the differences in expressive appreciation between class inclusion and non-humorous items among Group II subjects and among Group III subjects. Expressive appreciation was significantly greater for class inclusion items than for non-humorous items among both Group II subjects $t(19)=4.58$, $p < .01$ and among Group III subjects $t(19)=10.86$, $p < .01$. However, significant differences were also found for Group I subjects $t(19) = 3.53$, $p < .01$ and Group IV subjects $t(19) = 4.37$, $p < .01$ in their responses to humorous as opposed to non-humorous items.

Weight conservation. The hypothesis that recent weight conservers (Group III) would demonstrate significantly higher expressive appreciation scores for weight conservation items than would non-conservers of weight (Groups I and II) and than older weight conservers (Group IV) was partially supported. A priori comparisons indicated that Group III weight conservers expressed significantly greater appreciation for weight conservation items than did Group I subjects $F(1,76)=7.33$, $p < .01$. Group III subjects also demonstrated significantly greater expressive apprecation than did Group IV subjects $F(1,76)=5.90$, $p < .05$. However, Group III subjects and Group II subject scores were not significantly different.

The hypothesis that recent weight conservers (Groups III) would express significantly greater appreciation for

weight conservation jokes than for non-humorous items was supported. Repeated-measures two-tailed t-tests indicated that, among Group III subjects, expressive appreciation for weight conservation items was significantly greater than expressive appreciation for non-humorous items $t(19)=10.78$, $p < .01$. However, significant differences were also found between expressive response to non-humorous items and weight conservation items among subjects in each of the other three groups.

Further analyses. A 4x2 (operational level x humor type) repeated-measures analysis of variance performed on the data indicated main effects for operational level, $F(1,76)=5.19$, $p < .01$ and for humor type $F(1,76)=5.26$, $p < .05$. Spontaneous enjoyment was greater for class inclusion than weight conservation humor. A Newman Keuls test of paired comparisons indicated that Group III differed significantly from Groups I and IV at the $p < .05$ level of significance. Subjects recently operational in both class inclusion and weight conservation (Group III) expressed significantly greater appreciation for operational humor than did subjects who were preoperational (Group I) or whose acquisition of the operation was longer established (Group IV). Humor type did not interact with operational level.

Evaluative Appreciation

Class inclusion. A priori comparisons were conducted

to test the hypothesis that recent class includers (Groups II and III) would demonstrate significantly higher evaluative appreciation scores for class inclusion jokes than would non-includers (Group I) and older class includers (Group IV). The hypothesis was partially supported, in that the ratings given by recent class includers were higher than those given by older subjects. It was found that Group III subjects gave signficantly higher funniness rating to class inclusion jokes than did Group IV subjects $F(1,76)=13.77$, $p < .01$. Group II subjects also evaluated the jokes as more humorous than did Group IV subjects, $F(1,76)=8.95$, $p < .01$ However, unexpectedly high evaluative appreciation ratings were given to class inclusion jokes by preoperational subjects (Group I). Therefore, the predicted differences in evaluative appreciation between same age class includers and non-includers were not found.

It was also hypothesized that recent class includers (Groups II and III) would demonstrate greater evaluative appreciation for the class inclusion jokes than they would for the non-humorous control items. This hypothesis was supported. Repeated-measures two-tailed t-tests indicated that Group II subjects gave class inclusion jokes significantly higher funniness ratings than they did non-humorous items $t(19)=4.33$, $p < .01$. Similarly, Group III subjects rated the class inclusion jokes as funnier than they did the non-humorous items $t(19)=7.66$, $p < .01$. While Group IV sub-

jects also gave higher ratings to humorous than non-humorous items, $t(19) = 7.21$ $p < .01$, Group I subjects did not discriminate between humorous and non-humorous items in their ratings.

As can be seen in Table 8, the highest evaluative appreciation scores for class inclusion items were demonstrated by Group III subjects. Subjects in Groups I and II demonstrated surprisingly similar scores and there was a significant drop in evaluative appreciation among Group IV subjects.

Weight Conservation. The hypothesis that recent weight conservers (Group III) would demonstrate significantly higher evaluative appreciation scores for weight conservation jokes than would non-conservers (Groups I and II) and older weight conservers (Group IV) was only partially supported. Contrary to prediction, the non-conserving subjects in Groups I and II gave weight conservation jokes somewhat higher funniness ratings than did recent weight conservers. However, a priori comparisons indicated significantly higher evaluative appreciation for these jokes among recent weight conservers (Group III) than among older weight conservers (Group IV), $F(1,76)=6.08$, $p < .01$.

Repeated-measures two-tailed t-tests indicate that recent weight conservers evaluated the weight conservation jokes as funnier than they did the non-humorous control items $t(19)=6.34$, $p < .01$. However, subjects in the other

three groups also rated the weight conservation jokes as significantly funnier than the non-humorous items.

Further Analyses. A 4x2 (operational level x humor type) analysis of variance for evaluative appreciation indicated a significant main effect for operational level, $F(1,76)=7.79$, $p< .01$. A Newman Keuls analysis indicated that Group IV evaluative appreciation was significantly lower than that of the other three groups at the .05 level of significance. Humor type was not a significant main effect nor did it interact with operational level.

Operative Recall

Operative recall was recorded after a five minute delay interval and again after a ten to fourteen day delay interval. A subject's recall response received either a 0 or 1 score for each item. At each delay interval a maximum of 4 points could be attained for recall of class inclusion items and a maximum of 4 points for recall of weight conservation items. Analyzing responses for both class inclusion and weight conservation items at both delay intervals required using a 4x2x2 (operational level x delay interval x humor type) analysis of variance. A priori comparisons were used to test the hypotheses. Means and Standard deviations for operative recall after five minutes are shown in Table 9. Means and Standard deviations for operative recall after ten to fourteen days are found in Table 10.

Table 9

Means and Standard Deviations of Operative Recall Scores on Class Inclusion and Weight Conservation Jokes After a Five Minute Delay Interval

	Humor Type			
Level	Class Inclusion		Weight Conservation	
	M	SD	M	SD
I	1.05	1.19	1.20	1.24
II	1.30	.86	1.80	1.15
III	1.90	1.20	2.35	1.13
IV	2.05	1.15	2.40	1.09

Note: Range of scores 0 to 4 for class inclusion; 0 to 4 for weight conservation.

Table 10

Means and Standard Deviations of Operative Recall Scores on Class Inclusion and Weight Conservation Jokes After a Ten to Fourteen Day Delay Interval

Level	Humor Type			
	Class Inclusion		Weight Conservation	
	M	SD	M	SD
I	1.35	1.04	1.15	1.31
II	1.75	1.52	1.55	1.43
III	2.05	1.10	2.15	.99
IV	2.85	1.13	2.75	1.07

Note: Range of scores 0 to 4 for class inclusion; 0 to 4 for weight conservation.

Operative Recall After a Five Minute Interval

Class inclusion. It was predicted that recent class includers (Groups II and III) would demonstrate greater operative recall for class inclusion items than would non-includers (Group I). A priori comparisons indicated that after a five minute delay interval, operative recall scores of Group III includers were significantly higher than operative recall scores of non-includers (Group I) $F(1,76)=6.74$, $p < .05$. However, there was no significant difference between scores of non-includers and Group II includers.

Weight Conservation. A priori comparisons indicated that after a five minute delay interval, recent weight conservers (Group III) demonstrated significantly greater operative recall for weight conservation items than did Group I non-conservers $F(1,76)=9.88$, $p < .01$. However, differences between Group II non-conservers and the recent conservers in Group III did not reach levels of significance.

Operative Recall After Ten to Fourteen Days

Class Inclusion. A priori comparisons indicated that after ten to fourteen days, the difference in operative recall between recent class includers (Groups II and III) and non-includers (Group I) was not significant.

Weight Conservation. After the longer delay interval, a priori comparisons indicated that recent weight conservers (Group III) continued to demonstrate significantly greater operative recall scores for weight conservation jokes than did Group I non-conservers, $F(1,76)=6.80$, $p < .05$.

Three Factor Analysis of Operational Recall

A 4x2x2 (operative level x delay interval x humor type) analysis of variance was conducted to analyze operative recall data. Main effects were found for operational level $F(1,76)=9.23$, $p < .01$. A Newman Keuls post hoc test of the results indicated that Group IV subjects exhibited greater operative recall than either Group I or Group II subjects. Group III subjects demonstrated greater operative recall than did Group I subjects, $p < .05$.

While there were no main effects for either delay interval or humor type, there was a significant interaction between operational level, delay interval and humor type, $F(1,76)=7.41$, $p < .01$. For Groups I, II and III, class inclusion scores increased from the first to the second delay intervals, while weight conservation scores decreased from the first to second delay intervals. Among Group IV subjects, operative recall for both class inclusion and weight conservation items increased from the first delay interval to the next.

Figurative Recall

Figurative recall scores at each of the two delay intervals ranged from 0 to 25 for class inclusion items and 0 to 25 for weight conservation items. Hypotheses regarding figurative recall involved comparisons over delay intervals. It was hypothesized that all subjects would exhibit greater figurative recall after five minutes than after ten to fourteen days. Means and standard deviations for figurative recall after a five minute delay interval are shown on Table 11 and after a ten to fourteen day delay interval are shown on Table 12.

A 4x2x2 (operational level x delay interval x humor type) analysis of variance indicated main effects for operational level $F(1,76)=3.49$, $p < .05$; delay interval $F(1,76)=12.21$, $p < .01$; and humor type, $F(1,76)=7.02$, $p < 01$. There was also a delay interval x humor type interaction, $F(1,76)=6.10$, $p < .05$.

Contrary to prediction, figurative recall was significantly greater after the ten to fourteen delay interval than after the five minute delay interval. Figurative recall for class inclusion items was significantly greater than was figurative recall for weight conservation items, particularly after ten to fourteen days.

A Newman Keuls post hoc test of the operational level factor indicated that Group IV scores were significantly higher than Group I scores at the $p < .05$ level. Older

Table 11

Means and Standard Deviations of Figurative Recall Scores on Class Inclusion and Weight Conservation Jokes After a Five Minute Delay Interval

	Humor Type			
Level	Class Inclusion		Weight Conservation	
	M	SD	M	SD
I	7.65	5.39	7.50	4.66
II	9.35	5.11	8.35	4.21
III	10.35	4.53	11.10	5.13
IV	11.60	5.35	10.70	3.81

Note: Range of scores 0 to 25 for class inclusion; 0 to 25 for weight conservation.

Table 12

Means and Standard Deviations of Figurative Recall Scores on Class Inclusion and Weight Conservation Jokes After a Ten to Fourteen Day Delay Interval

	Humor Type			
Level	Class Inclusion		Weight Conservation	
	M	SD	M	SD
I	9.50	4.57	9.50	4.52
II	11.55	7.44	8.55	6.38
III	12.45	5.68	11.75	5.03
IV	15.10	4.88	11.70	4.60

Note: Range of scores 0 to 25 for class inclusion; 0 to 25 for weight conservation.

subjects (Group IV) demonstrated significantly greater figurative recall than did preoperational younger subjects (Group I) but not than operational younger subjects (Groups II and III).

Relationships Between Dependent Measures

Besides assessing the relationship between operational levels for each of the dependent variables, the study sought to determine how the dependent variables were correlated with each other. Significant correlations which have a bearing on the present investigation will be presented. The following results are based on responses for the 80 subjects in the sample, and all significant correlations reported are positive. Correlations between responses to class inclusion jokes are shown in Table 13. Correlations between responses to weight conservation jokes are shown in Table 14.

Comprehension

There was a high positive correlation between comprehension for class inclusion and weight conservation humor $r = .61$, $p < .01$. Comprehension for both class inclusion and weight conservation were highly correlated with the recall measures, particularly recall for class inclusion. Comprehension for class inclusion humor was correlated with: operative recall for class inclusion humor after a five minute delay $r = .52$, $p < .01$ and after the longer delay $r = .61$, $p < .01$; figurative recall for class inclusion humor

Table 13

Correlations Between Responses to Class Inclusion Jokes

	Comprehension	Expressive Appreciation	Evaluative Appreciation	Operative Recall After Five Minutes	Operative Recall After 10-14 Days	Figurative Recall After Fibe Minutes	Figurative Recall After 10-14 Minutes
Comprehension	1.00	.22	.06	.52**	.61**	.53**	.46**
Expressive Appreciation	.22	1.00	.74**	.28*	.30**	.27*	.29*
Evaluative Appreciation	.06	.74**	1.00	.17	.14	.22*	.14
Operative Recall After Five Minutes	.52**	.28*	.17	1.00	.53**	.83**	.46**
Operative Recall After 10-14 Days	.61**	.30**	.14	.53**	1.00	.51**	.83**
Figurative Recall After Five Minutes	.53**	.27*	.23*	.83*	.51**	1.00	.51**
Figurative Recall After 10-14 Days	.46**	.29*	.14	.46**	.83**	.51**	1.00

Note: n = 80

* $p < .05$

** $p < .01$

Table 14

Correlations Between Responses to Weight Conservation Jokes

	Comprehension	Expressive Apreciation	Evaluative Appreciation	Operative Recall After Five Minutes	Operative Recall After 10-14 Days	Figurative Recall After Five Minutes	Figurative Recall After 10-14 Minutes
Comprehension	1.00	.01	.23*	.33**	.48**	.24*	.28*
Expressive Appreciation	.01	1.00	.58**	.23*	.01	.25*	.06
Evaluative Appreciation	.23*	.58**	1.00	.07	.15	.08	.06
Operative Recall After Five Minutes	.33**	.23*	.07	1.00	.56**	.79**	.56**
Operative Recall After 10-14 Days	.48**	.01	.15	.56**	1.00	.47	.76**
Figurative Recall After Five Minutes	.24*	.25*	.08	.79**	.47**	1.00	.62**
Figurative Recall After 10-14 Days	.28*	.06	.06	.56**	.76**	.62*	1.00

Note: n = 80

* $p < .05$

** $p < .01$

after a five minute delay $r = .53$, $p < .01$ and after the longer delay $r = .46$, $p < .01$. The correlations between comprehension for class inclusion humor and recall for weight conservation humor were also highly significant.

Comprehension for weight conservation humor was also correlated with the recall measures. Comprehension for weight conservation humor was correlated with operational recall after five minutes: for weight conservation, $r = .33$, $p < .01$, and for class inclusion, $r = .39$, $p < .01$. Operative recall after the ten to fourteen day delay interval correlated with comprehension for weight conservation humor: $r = .48$, $p < .01$ for weight conservation recall; $r = .46$, $p < .01$ for class inclusion recall. Correlations between comprehension for weight conservation humor and figurative recall for weight conservation jokes were $r = .24$, $p < .05$ after five minutes and $r = .28$, $p < .05$ after ten to fourteen days.

While comprehension was highly correlated with both figurative and operative recall, there were no significant correlations between comprehension meaures and either of the two appreciation measures.

Expressive Appreciation

Expressive appreciation for class inclusion and weight conservation humor were strongly correlated, $r = .55$, $p < .01$. Expressive appreciation for class inclusion humor was

highly correlated with evaluative appreciation for class inclusion humor $r = .74$, $p < .01$, but not as highly correlated with evaluative appreciation for weight conservation $r = .37$, $p < .001$.

Expressive appreciation for class inclusion humor was also correlated with operative recall for class inclusion after the brief delay interval $r = .28$, $p < .05$ and longer delay interval $r = .30$, $p < .01$. Correlations between expressive appreciation and figurative recall for class inclusion were $r = .27$, $p < .05$ for the five minute delay and $r = .29$, $p < .01$ for the longer delay.

Expressive appreciation for weight conservation humor only correlated with recall for weight conservation after the brief delay interval. The correlations were $r = .23$, $p < .05$ for operative and $r = .25$, $p < .05$ for figurative recall.

Evaluative Appreciation

Evaluative appreciation for class inclusion humor and evaluative appreciation for weight conservation humor were highly correlated $r = .52$, $p < .01$. As reported in the previous section, expressive appreciation and evaluative appreciation scores were also highly correlated with one another. Evaluative appreciation for weight conservation was correlated only with the other expressive and evaluative appreciation measures. In contrast, evaluative appreciation

for class inclusion was correlated with recall after the shorter delay interval: with operative recall for weight conservation $r = .27$, $p < .05$; figurative recall for weight conservation $r = .34$, $p < .01$ and figurative recall for class inclusion $r = .22$, $p < .05$. Evaluative appreciation for class inclusion was not correlated with operative memory for class inclusion.

Operative Recall

Operative recall, after the brief delay interval, was highly correlated with several other measures. Most notable were the high positive correlations between operative and figurative recall for class inclusion humor $r = .83$, $p < .01$ and between operative and figurative recall for weight conservation humor $r = .79$, $p < .01$.

After the longer delay interval, the correlation between operative and figurative recall for class inclusion was still $r = .83$, $p < .01$ for class inclusion, and $r = .76$, $p < .01$ for weight conservation.

The correlations between operative recall for class inclusion and weight conservation humor were $r = .51$, $p < .01$ after five minutes and $r = .63$, $p < .01$ after the longer delay.

The correlations between operative recall after the first and second delay intervals were also highly significant. For class inclusion the correlation between scores

for the two delay intervals was $r = .53$, $p < .01$. For weight conservation recall the correlation was $r = .56$, $p < .01$.

As noted earlier, operative recall was more consistently correlated with expressive than evaluative appreciation scores. Also reported earlier were the high correlations between operative recall and comprehension.

Figurative Recall

Figurative recall for class inclusion and for weight conservation humor were correlated after both the brief delay $r = .61$, $p < .01$ and after the longer delay $r = .68$, $p < .01$.

Figurative recall for class inclusion after five minutes was correlated with figurative recall for class inclusion after ten to fourteen days $r = .51$, $p < .01$.

Figurative recall for weight conservation humor was also correlated between the two delay intervals, $r = .62$, $p < .01$.

The high correlations between figurative and operative recall have already been reported.

Figurative recall was highly correlated with comprehension. Figurative recall for class inclusion after the first delay interval was correlated with comprehension of weight conservation jokes $r = .36$, $p < .01$ and class inclusion jokes $r = .53$, $p < .01$. Figurative recall for weight conservation humor after five minutes correlated with comprehension for

weight conservation jokes $r = .24$, $p < .05$ and class inclusion jokes $r = .44$, $p < .01$. The relationship between comprehension and figurative recall remained relatively stable over time.

CHAPTER V

Discussion

The results of the present study partially confirm the hypotheses that operational level is predictive of humor comprehension, appreciation and recall. To a great extent, the study supports the Piagetian position that a child's level of cognitive maturity affects his understandings and performance in a range of conditions. Among children the same age, those who had attained the necessary operativity demonstrated greater comprehension, expressive appreciation and operative recall than their operationally less advanced peers.

The study makes a particular contribution to an understanding of the development of memory for humor; an area that has received little attention from researchers studying either recall or humor (Foot, Sweeny and Chapman 1978; Davies and Apter 1980).

Retention of both the operative and figurative elements of humor increased with cognitive level among same-age-range peers, with short-term operative memory reflecting the strongest differences between operational and preoperational children. The memory findings partially support the Piagetian argument that memory is reflective of more general cognitive functioning (Piaget and Inhelder, 1973; Liben, 1977a), a position also supported by the strong association

between memory and comprehension. While comprehension and appreciation were not correlated with each other, recall was associated with both an understanding and enjoyment of humor. Memory for humor would appear to be related to both cognitive and affective functioning.

Comprehension for humor most sensitively reflected the operational level of subjects, for it was on this measure that the specificity sought in the design was supported. Children who had attained operativity in one area but not another exhibited the selective comprehension predicted. Thus the phenomenon of horizontal decalage (Piaget, 1963; Piaget and Inhelder, 1973) was found in the present investigation with regard to humor comprehension.

The cognitive congruency principle (Zigler, Levine and Gould, 1966; 1967; McGhee, 1976) was supported for expressive appreciation, while evaluative ratings appeared more subject to situational demands. The greatest spontaneous enjoyment was exhibited by children who had recently attained the concepts needed to master the humor and had to exert maximum effort to resolve the incongruity. Their older schoolmates found the jokes less challenging and less humorous.

The interpretation and theoretical implications of the findings for each variable will be discussed separately, followed by an attempt to integrate the results, draw some more general conclusions, and raise questions for further research.

Comprehension

As predicted by Piagetian theory, comprehension proved a finely tuned gauge of operational development. The findings for comprehension bear significance for several reasons. One is that they demonstrate the close association between performance on the relatively concrete cognitive assessment task and performance on a verbal measure in which a child was asked to respond to complex stimuli containing both relevant and extraneous elements. Not only was the humor in the study verbal, but each joke represented a 'twist' on reality, probably providing a more challenging test of comprehension than a more straight-forward presentation.

The present study found that cognitive level was associated with the ability to identify a critical incongruity corresponding to a particular concept. In this regard the study supported McGhee's research (1976). Moreover, the intermediate subjects in Group II, serving as their own control group, enabled the study to establish a finer distinction between comprehension for humor based on different operative areas as a function of cognitive ability in a particular area. The present study supports McGhee's findings (1976) but also presents new support for Piaget's theory by providing the specificity sought by Brodzinsky and Rightmeyer (1980). Piagetain theory recognizes that operativity in different areas emerges in the same child at

different times. Thus, at a given time a child may be operational in one area but not another. This phenomenon is known as horizontal decalage. The horizontal decalage found for humor comprehension provides new evidence that humor comprehension is exhibited when the cognitive difficulty of the task is closely matched to the cognitive capability of the individual (Brodzinsky and Rightmeyer, 1980). The match between the individual and the stimulus appears to be a decisive feature in the comprehension of cognitive humor.

Appreciation

Different patterns of results were reflected in the two appreciation measures. Expressive appreciation, more than evaluative appreciation, followed the model of the cognitive congruency principle (Zigler, Levine and Gould, 1966, 1967; McGhee, 1976). The two measures of appeal are used in conjunction in most humor development research (McGhee 1979) because they provide a balanced picture of appreciation. One measure evaluates spontaneous enjoyment while the other assesses a briefly deliberated judgment. Most studies of cognitive humor have found mirth responses to be lower than evaluative ratings (McGhee, 1979; Brodzinsky and Rightmeyer, 1980) and results of the present study followed this pattern.

Expressive Appreciation

Findings of the present investigation supported the cognitive congruency principle (Zigler, Levine & Gould, 1966; 1967). As predicted, the most cognitively advanced of the younger subjects exhibited greater mirth than did the older subjects or the preoperational younger subjects. Spontaneous enjoyment was appreciably lower among those children who did not have the capacity to understand the humor and those for whom the humor was no longer challenging than it was among recently operational children upon whom the humor placed optimal cognitive demands. Not surprisingly, the intermediate subjects in Group II exhibited more enjoyment than their preoperational peers and less than their fully operational peers. However, unlike comprehension which proved quite sensitive to the horizontal decalage, expressive appreciation in intermediate subjects was not as distinctly reflective of their transitional operational competence.

The findings of the present study differ from those of McGhee (1976) with regard to expressive appreciation. McGhee found mirth ratings uniformly low among subjects at all cognitive levels, with no distinctions based on operational level. His explanation is that the concentration required to give ratings and explanations inhibited children and inclined them to focus on their explanations rather than respond "freely in a relaxed context . . . ." While the

present study asked children for a judgment after each joke, explanations were not demanded until later. By providing a more relaxed setting the predicted differences in spontaneous enjoyment were able to emerge.

There are two other differences between the McGhee study and the present study which might have contributed to the difference in results, although neither appears as critical as the placement of the comprehension explanation in the sequence of tasks. One difference is that the jokes used in the present study included only words generally understood by first grade children. The McGhee humor included some more advanced words (e.g., Catholic) which may have been difficult for children and inhibited mirth even among those who were later able to explain the humor. Also, the jokes used in the present study were somewhat briefer than the jokes used by McGhee. Given the differences described, the humor in the present study may have been more immediately accessible to those with the cognitive requisites to understand. This and the more relaxed setting provided most likely contributed to the emergence of the distinctive response levels predicted.

Zigler, Levine and Gould (1966) formed the cognitive congruency principle based on measures of spontaneous smiling and laughing. The present investigation supports their findings and indicates that the cognitive congruency principle holds true with regard to spontaneous enjoyment of

cognitive humor under conditions where the difficulty level of the humor and the intellectual abilities of the listener are independently assessed.

The present study has implications for research on the role of discrepency in enjoyment (Berlyne, 1969; McGhee, 1976; Pein and Rothbart, 1980). The present investigation suggests that the relief following the effort required for successful assimilation of the discrepency may produce a pleasurable response (Berlyne, 1969). It is interesting to note that Berlyne's argument was more strongly suggested with regard to expressive than evaluative appreciation. Mischel (1971) asserts that Berlyne's theory, derived from a drive theory of motivation, cannot be applied to the self-directed thinking used in problem-solving. However, the spontaneous mirth exhibited in expessive appreciation may well have its roots in biological arousal. Brodzinsky's research has shown that different personality and stimulus factors contribute to expressive as opposed to evaluative responses (Brodzinsky and Rightmeyer 1980). The present study indicates that spontaneous affective enjoyment of a discrepency is greatest when the discrepency is based on a newly acquired concept. The findings therefore lend support to the view that enjoyment is greatest when optimal effort must be exerted to resolve a discrepency (Berlyne, 1969; Zigler, Levine and Gould, 1966, 1967).

Evaluative Appreciation

The results of evaluative appreciation ratings followed the predicted pattern for operational subjects but not for preoperational subjects. As expected, subjects who had recently become operational in class inclusion and weight conservation gave higher ratings to the jokes in each area than did older operational subjects who were not challenged by the humor. However, preoperational children gave the jokes unexpectedly high ratings. Contrary to prediction, the highest ratings for weight conservation jokes were made by the least advanced children.

The most plausible explanation for the unexpected finding lies in the situational demands of the task. While comprehension results indicate that preoperational subjects had low comprehension of the humorous items, subjects had been told to evaluate the relative humorousness of each item and were probably expecting to find some of the items funny. Results suggest that preoperational children may have assigned evaluative ratings fairly arbitrarily, since they gave relatively high ratings to non-humorous items as well as humorous ones. Past research on humor has shown that social and situational factors contribute to subject expectations and responses (Chapman and Crompton, 1978; McGhee, 1979). Interestingly, the expressive appreciation exhibited by preoperational subjects was relatively low, suggesting

that their spontaneous mirth response may have been a truer indication of their comprehension and actual enjoyment of the jokes than their evaluative ratings.

Operative Recall

Operative recall followed the general patterns predicted, and provided partial support for Piaget's theory of memory organization. There was a step-by-step increase in operational memory for both types of humor with increased cognitive maturity. This finding is of interest because it helps support the cognitive developmental view that the greater memory capacity often associated with increases in chronological age may, in fact, reflect a more advanced ability to reconstruct and organize information in a meaningful way (see Liben, 1977a). In the present study the younger children were within the same age range but differed in cognitive ability. Yet, recall of the main point of the joke was greater among those younger children who were operationally competent in both class inclusion and weight conservation than among those who were not operational in either area. The prediction that the operative recall of intermediate subjects in Group II would reflect their specific operational abilities was not confirmed.

After the longer delay interval, the step-wise pattern persisted for both types of humor. Recall scores for the least to most cognitively mature subjects increased in in-

crements. However, differences between most and least cognitively mature same-age subjects remained significant only for weight conservation humor. It is somewhat puzzling that the direction of change over time for the two humor types differed. Among the younger subjects, there was an increase in recall of class inclusion humor and a decrease in memory for weight conservation humor. The fact that class inclusion acquisition generally precedes weight conservation acquisition may be a key to the difference.

In comparing findings from the first and second delay intervals it must be remembered that the comprehension task intervened between the two delay intervals. While the comprehension task immediately followed the first recall task and preceded the second recall interview by ten to fourteen days, the intervention of the comprehension task may have nevertheless affected recall after the longer delay interval. Children, while explaining the basis of the humor, had not only an additional exposure to each joke, but the opportunity to actively organize their responses to provide a verbal explanation. Such active organization is associated with heightened recall (Brown, 1975). Figurative recall, especially for class inclusion, increased for both types of humor over delay intervals. Figurative recall, highly correlated with operative recall, may have affected operative retention of class inclusion humor. The additional exposure and activity with the stimuli may have selectively facili-

tated memory performance on the task related to the better consolidated class inclusion skill.

The findings partially support Piaget's theory of memory (1973) by demonstrating how memory performance is related to the intellectual schemes of the child. Operative memory was not as finely-tuned a gauge of operative level as was comprehension. There may be affective and situational factors such as arousal, motivation and intention that are more likely to affect memory for humor (Chapman, 1973; Dolinsky, 1978; Foot, Sweeny and Chapman, 1978) than to affect comprehension. However, operative memory, in this case the verbal recall of cognitive jokes, generally reflected the same operational schemes of subjects which had originally been identified in the cognitive assessment.

Operative recall was positively correlated with both comprehension and expressive appreciation. It would appear that both enjoyment and understanding contribute to recall. Among children in the same age range, those who expressed the most spontaneous enjoyment and who exhibited the greatest comprehension were also those who best recalled the jokes both after five minutes and after 10 to 14 days.

Figurative Recall

Figurative recall increased with cognitive level. However, unlike operative recall, differences in figurative recall between children in the same age range were not

statistically significant. Figurative recall was closely associated with comprehension and expressive appreciation, and also highly correlated with operative recall. Figurative recall for cognitive humor proved to be more closely related to the other measures than had been anticipated. Piaget (1963; Piaget and Inhelder, 1973) posits that cognitive schemes mediate figurative functioning, however, he also suggests that figurative elements, based on imitations rather than transformations of reality, are less integrally tied to the intellectual capacities of the child than are operative schemes (Piaget and Inhelder, 1973; Liben 1977a, Liben 1977b). In the present study, figurative functioning appeared to be closely related to cognitive functioning.

It was predicted in the present study that figurative memory would fade over time and that among all groups figurative recall would decline. While many of the other hypotheses of the present study were supported, the figurative results proved contrary to expectations. Figurative recall improved significantly from the first to the second session.

The most likely explanation for figurative recall increases lies with the placement of the comprehension task; an explanation already posited with regard to operative memory increases. Both the repeated exposure and the comprehension activity with the stimuli may explain the unex-

pected improvement (Brown, 1975; Liben, 1977a). Other factors may have also contributed to the increases. Subjects were asked not to tell the stories to other children in their school. However, they may have nevertheless repeated the stories to each other in school, to friends outside of school, or rehearsed them privately. Even a child rehearsing an idiosyncratic version of a joke would have gained figurative practice through the retelling. It should be noted that while possible rehearsal may have contributed to figurative memory improvements, the intervention of the comprehension task is a more plausible explanation since it was a condition present for all subjects.

Conclusion

By following humor processing through several steps, a more coherent view has emerged of how the schemes underlying intellectual development operate in the complex area of the humor response. The present study extends past research by investigating humor within a horizontal decalage and providing new insights into humor recall. The present investigation suggests that cognitive level plays a major role in how humor is understood, enjoyed and encoded.

Comprehension and operative recall of humor reflected intellectual competence to varying degrees. The ability to identify and reconstruct a critical incongruity was generally related to a subject's acquisition of the concept

violated in the humor. Comprehension proved a sensitive reflection of the horizontal decalage. Operative recall, however, was not sensitive to developmental differences between the intermediate subjects and those who were either preoperational or operational in both areas tested. The findings can be interpreted within the context of research investigating analogous functioning across tasks and domains. Cognitive developmental research has found parallels between children's cognitive competence and performance in a range of activities (Inhelder, Sinclair and Bovet, 1974; McGhee, 1976; Prawat and Cancelli, 1976). The present investigation supports the Piagetian model with regard to the processing of verbal, cognitive humor.

The present study provides support to Piaget's model of development by demonstrating that certain developmental patterns may exist not only in how humor is comprehended and enjoyed (Zigler, Levine and Gould, 1966, 1967; McGhee, 1976) but also how it is recalled. Children's reconstructions of operational jokes soon after presentation reflected differences between the most and least cognitively mature same-age subjects. The strong correlations between comprehension and both recall measures also suggest that intellectual competence may underlie response to cognitive humor. Several of the findings of the present study support a Piagetian view of intellectual development.

Affect, according to Piaget, helps motivate and energize cognitive activity (Piaget 1962; 1963). However, Piaget also posits that affective behavior itself is defined, in large part, by the cognitive schemes of the individual. According to Brodzinsky and Rightmeyer (1980), few areas of research integrate the study of both affect and cognition. Humor is one area of research that has attempted to coordinate both areas of functioning.

The present study suggests that cognitive processing is one factor influencing affective response to humor, but that other factors also play a role. Expressive appreciation was greatest when the cognitive demands of the humor required an optimal effort on the part of the individual for mastery and resolution. With respect to expressive appreciation the present findings support the cognitive congruency principle (Zigler, Levine and Gould, 1966, 1967; McGhee, 1976) and suggest that cognition, specifically the recent mastery of concepts, plays a major role in enjoyment. In contrast to expressive appreciation, evaluative appreciation appeared subject to situational demands. Other studies have found expressive appreciation the more mercurial of the appreciation measures (McGhee, 1976; Brodzinsky and Rightmeyer, 1980). Affective response to humor may be a less stable or consistent reflection of cognitive functioning than either comprehension or memory.

Relevant to an interpretation of the present study is the literature on constructive memory in narrative recall (Brown, Smiley, Day, Townsend and Lawton 1977; Mandler, Scribner, Cole and DeForest, 1980; Paris and Lindauer, 1977) and recent investigations of recall for 'real life' events (Nelson and Gruendel, 1981). Paris and Lindauer (1977) propose that "memory is a dynamic, constructive process in which there are reciprocal interactions between the individual's cognitive schemata and new information." They provide evidence for "semantic integration" in which inferential relationships implied in prose presentations are constructed and "remembered" even if they have never actually been presented.

Brown, Smiley, Day, Townsend and Lawton (1977) suggest that schemata provide the framework for story comprehension and recall in both children and adults. Also suggesting the use of schematic organization in narrative recall is the work of Mandler, Scribner, Cole and DeForest (1980). Their cross-cultural study suggests that the schemata used in narrative recall may have some universal characteristics, and may not reflect the developmental differences found in recall for categorically organized material.

Nelson and Gruendel, 1981, have studied the schema used by children in understanding and remembering "scripts." A script is defined as a "schematic organization that repre-

sents an event structure based on experience in the real world" (Nelson, Fivush, Hudson and Lucariello, in press). While memory for scripts involves an interaction between general and specific memory, Nelson and Gruendel (1981) suggest that young children first form scripts that fuse specific content into general schema which parallel Piaget's "memory in a broad sense" (Piaget and Inhelder, 1973). Over time, children's memory for scripts becomes more complex, detailed and situation-specific. Scripts are based on spatially and temporally organized expectations rather than the logically based schemes posited by Piaget.

In interpreting the results of the present study, it might be considered that the jokes presented violations of children's scripts as well as their logical expectations. The "idiosyncratic" responses of preoperational children may, in fact, reflect more systematic interpretations of the jokes than would be predicted from a strictly Piagetian viewpoint. The study of humor within the context of children's narrative recall and recall of scripts presents a worthwhile area for future investigation.

There are a few implications of the present investigation that are worth noting. Humor understanding and recall are greatest when the individual has the skills needed to process the humor. Enjoyment is optimized when such skills have been only recently acquired. For these reasons, humor might best be used to reinforce and build on recently

mastered concepts. The present study also suggests that, with repeated exposure and activity, memory for humor may improve. For this reason, humor might be effectively utilized in learning, especially when the humor is related to the information to be learned.

The study suggests a number of related questions for further investigation. One area which has not been studied directly is how memory for humorous incongruities compares to memory for non-humorous incongruities. Does the humorous basis of an incongruity motivate an individual to remember it better? The present study touches upon such questions but does not provide a complete answer. A related question for further investigation is how task demands affect memory. Would recall of jokes be enhanced if children were told that they were going to be asked to retell them? The question of children's awareness of their own humor processing has received little attention in past research and could provide insights into an area that integrates many aspects of behavior (Brodzinsky and Rightmeyer, 1980).

Humor presents a promising area for further research. As an important feature of most children's social and intellectual environments, it has 'real life' implications and applications. One of the unique features of humor is that it provides a gauge of development that integrates intellectual and affective areas of functioning. By providing a

measure of cognitive organization that is not based solely on verbal expression, humor has the potential to reflect multidimensional psychological processing in much the same way that Charlesworth (1969) suggested surprise reflected such processing. Understanding, appreciating and remembering humor require the child to solve a problem in which information is often complex, embedded and reversed from the usual form. The competence needed to resolve the humor, the effort required for mastery and the schemes underlying retention prove an intriguing area for further investigation.

Table A

Frequency Distribution of Scores for Expressive Appreciation of Class Inclusion Items

Score	Group I	Group II	Group III	Group IV	Total
4	2	2	0	1	5
5	2	2	0	2	6
6	2	1	2	3	8
7	3	2	1	5	11
8	6	0	2	1	9
9	1	4	0	1	6
10	1	1	3	3	8
11	1	1	5	3	10
12	0	3	2	1	6
13	1	2	0	0	3
14	0	1	3	0	4
15	0	1	2	0	3
16	1	0	0	0	1

Note: Range of possible scores = 4 - 16.

Range of scores for Group I = 4 - 16

Range of scores for Group II = 4 - 15

Range of scores for Group III = 6 - 15

Range of scores for Group IV = 4 - 12

Table B

Frequency Distribution of Scores for Expressive Appreciation of Weight Conservation Items

Score	Group I	Group II	Group III	Group IV	Total
4	1	1	0	0	2
5	3	1	1	2	7
6	3	3	1	4	11
7	4	1	0	3	8
8	3	4	5	6	18
9	4	4	5	1	14
10	1	2	3	3	9
11	0	0	2	1	3
12	0	2	0	0	2
13	0	1	2	0	3
14	1	0	1	0	2
15	0	1	0	0	1
16	0	0	0	0	0

Note: Range of possible scores = 4 - 16.

Range of Scores for Group I = 1 - 14

Range of Scores for Group II = 1 - 15

Range of Scores for Group III = 5 - 14

Range of Scores for Group IV = 0 - 11

Table C

Frequency Distribution of Scores for Expressive Appreciation of Non-humorous Items

Score	Group I	Group II	Group III	Group IV	Total
4	5	9	12	13	39
5	7	5	4	3	19
6	4	0	3	3	10
7	3	3	0	0	6
8	0	3	1	0	4
9	0	0	0	0	0
10	1	0	0	0	1
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	1	1
16	0	0	0	0	0

Note: Range of possible scores = 4 - 16.

Range of scores for Group I = 4 - 10

Range of scores for Group II = 4 - 8

Range of scores for Group III = 4 - 8

Range of scores for Group IV = 4 - 15

Table D

Frequency Distribution of Scores for Evaluative Appreciation of Class Inclusion Items

Score	Group I	Group II	Group III	Group IV	Total
4	0	0	0	2	2
5	1	0	1	3	5
6	0	0	1	1	2
7	1	3	1	4	9
8	3	2	0	1	6
9	4	1	3	1	9
10	3	6	2	5	16
11	2	2	1	2	7
12	0	1	3	1	5
13	1	2	3	0	6
14	3	1	3	0	7
15	0	0	0	0	0
16	2	2	2	0	6

Note: Range of possible scores = 4 - 16.

Range of scores for Group I = 5 - 16

Range of scores for Group II = 7 - 16

Range of scores for Group III = 5 - 16

Range of scores for Group IV = 5 - 11

Table E

Frequency Distribution of Scores for Evaluative Appreciation of Weight Conservation Items

Score	Group I	Group II	Group III	Group IV	Total
4	0	0	1	4	5
5	1	0	2	0	3
6	2	1	1	3	7
7	0	1	2	5	8
8	1	3	2	2	8
9	1	2	1	3	7
10	3	3	2	2	10
11	4	2	2	0	8
12	1	4	1	0	6
13	2	2	3	1	8
14	3	1	0	0	4
15	1	1	1	0	3
16	1	0	2	0	3

Note: Range of possible scores = 4 - 16.

Range of scores for Group I = 5 - 16

Range of scores for Group II = 6 - 15

Range of scores for Group III = 2 - 16

Range of scores for Group IV = 4 - 13

Table F

Frequency Distribution of Scores for

Evaluative Appreciation of Non-humorous Items

Score	Group I	Group II	Group III	Group IV	Total
4	2	7	7	17	33
5	1	4	5	0	10
6	2	0	4	3	9
7	2	1	1	0	4
8	3	3	2	0	8
9	4	1	0	0	5
10	1	1	0	0	2
11	1	2	1	0	4
12	1	1	0	0	2
13	1	0	0	0	1
14	2	0	0	0	2
15	0	0	0	0	0
16	0	0	0	0	0

Note: Range of possible scores = 4 - 16.

Range of scores for Group I = 4 - 14

Range of scores for Group II = 4 - 12

Range of scores for Group III = 4 - 11

Range of scores for Group IV = 4 - 6

Table G

Frequency Distribution of Scores for

Comprehension of Class Inclusion Items

Score	Group I	Group II	Group III	Group IV	Total
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	1	0	0	1
8	1	0	0	0	1
9	1	0	0	0	1
10	1	0	0	0	1
11	3	0	0	1	4
12	2	0	3	0	5
13	2	2	0	0	4
14	1	3	1	0	5
15	4	1	0	0	5
16	0	4	1	0	5
17	1	0	3	2	6
18	3	7	2	3	15
19	0	0	1	4	5
20	1	2	9	10	22

Note: Range of possible Scores = 4 - 20

Range of Scores for Group I = 8 - 20
Range of Scores for Group II = 7 - 20
Range of Scores for Group III = 12 - 20
Range of Scores for Group IV = 11 - 20

Table H

Frequency Distribution of Scores for

Comprehension of Weight Conservation Items

Score	Group I	Group II	Group III	Group IV	Total
4	0	1	0	0	1
5	0	1	0	0	1
6	0	0	0	0	0
7	0	1	1	0	2
8	1	2	1	0	4
9	2	0	1	0	3
10	5	0	0	0	5
11	2	0	0	0	2
12	3	7	0	1	11
13	2	2	2	1	7
14	1	2	5	2	10
15	1	1	1	1	4
16	2	2	5	2	11
17	0	0	3	1	4
18	1	1	1	3	6
19	0	0	0	2	2
20	0	0	0	7	7

Note: Range of possible scores = 4 - 20.

Range of scores for Group I = 8 - 18
Range of scores for Group II = 1 - 18
Range of scores for Group III = 7 - 18
Range of scores for Group IV = 12 - 20

Table I

Frequency Distribution of Scores for Operative Recall of Class Inclusion Items After a Five Minute Delay Interval

Score	Group I	Group II	Group III	Group IV	Total
0	9	4	2	0	15
1	4	7	5	6	22
2	5	8	6	8	27
3	1	1	7	3	12
4	1	0	0	3	4

Note: Range of possible scores = 0 - 4.

Range of scores for Group I = 0 - 4

Range of scores for Group II = 0 - 3

Range of scores for Group III = 0 - 3

Range of scores for Group IV = 1 - 4

Table J

Frequency Distribution of Scores for Operative Recall of Weight Conservation Items After a Five Minute Delay Interval

Score	Group I	Group II	Group III	Group IV	Total
0	8	2	1	1	12
1	4	8	3	3	18
2	5	3	8	6	22
3	2	6	4	7	19
4	1	1	4	3	9

Note: Range of possible scores = 0 - 4.

Range of scores for Group I = 0 - 4

Range of scores for Group II = 0 - 4

Range of scores for Group III = 0 - 4

Range of scores for Group IV = 0 - 4

Table K

Frequency Distribution of Scores for Operative Recall of Class Inclusion Items after a 10-14 Day Delay Interval

Score	Group I	Group II	Group III	Group IV	Total
0	9	7	1	1	18
1	3	3	4	2	12
2	6	4	7	2	19
3	0	4	7	11	22
4	2	2	1	4	9

Note: Range of possible scores = 0 - 4

Range of scores for Group I = 0 - 4

Range of scores for Group II = 0 - 4

Range of scores for Group III = 0 - 4

Range of scores for Group IV = 0 - 4

Table L

Frequency Distribution of Scores for Operative Recall of Weight Conservation Items After a 10-14 Day Delay Interval

Score	Group I	Group II	Group III	Group IV	Total
0	5	7	1	1	14
1	8	2	6	1	17
2	3	4	8	5	20
3	4	3	2	5	14
4	0	4	3	8	15

Note: Range of possible scores = 0 - 4.

Range of scores for Group I = 0 - 4

Range of scores for Group II = 0 - 4

Range of scores for Group III = 0 - 4

Range of scores for Group IV = 0 - 4

Table M

Frequency Distribution of Scores for Figurative Recall of Class Inclusion Items After a Five Minute Delay Interval

Score Interval	Group I	Group II	Group III	Group IV	Total
0 - 5	6	5	4	2	17
6 - 10	7	9	5	10	31
11 - 15	7	4	7	6	24
16 - 20	0	2	4	2	8
21 - 25	0	0	0	0	0

Note: Range of possible scores = 0 - 25.

Range of scores for Group I = 0 - 15

Range of scores for Group II = 0 - 17

Range of scores for Group III = 0 - 18

Range of scores for Group IV = 3 - 17

Table N

Frequency Distribution of Scores for Figurative Recall of Weight Conservation Items After a Five Minute Delay Interval

Score Interval	Group I	Group II	Group III	Group IV	Total
0 - 5	7	5	4	2	18
6 - 10	9	6	5	10	30
11 - 15	1	7	8	4	20
16 - 20	3	2	3	3	11
21 - 25	0	0	0	1	1

Note: Range of possible scores = 0 - 25.

Range of scores for Group I = 0 - 18

Range of scores for Group II = 0 - 18

Range of scores for Group III = 3 - 17

Range of scores for Group IV = 3 - 23

Table O

Frequency Distribution of Scores for Figurative Recall of Class Inclusion Items After a 10-14 Day Delay Interval

Score Interval	Group I	Group II	Group III	Group IV	Total
0 - 5	3	8	2	1	14
6 - 10	10	4	6	7	27
11 - 15	4	4	7	7	22
16 - 20	3	4	5	5	17
21 - 25	0	0	0	0	0

Note: Range of possible scores = 0 - 25.

Range of scores for Group I = 2 - 17

Range of scores for Group II = 0 - 19

Range of scores for Group III = 0 - 20

Range of scores for Group IV = 4 - 18

Table P

Frequency Distribution of Scores for Figurative Recall of Weight Conservation Items After a 10-14 Day Delay Interval

Score Interval	Group I	Group II	Group III	Group IV	Total
0 - 5	4	6	2	1	13
6 - 10	8	2	5	3	18
11 - 15	6	2	7	5	20
16 - 20	2	9	5	8	24
21 - 25	0	1	1	3	5

Note: Range of possible scores = 0 - 25.

Range of scores for Group I = 0 - 19

Range of scores for Group II = 0 - 21

Range of scores for Group III = 0 - 21

Range of scores for Group IV = 3 - 21

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