DOCUMENT RESUME

ED 136 950 PS 009 197

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TITLE Modeling and Self-Regulatory Mechanisms as Determinants of Self-Control.
PUB DATE Apr 76
NOTE 40p.; Portions of this paper were presented at the Biennial Southeastern Conference on Human Development (4th, Nashville, Tennessee, Arpil 15-17, 1976)

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS Age Differences; *Cognitive Development; *Elementary Education; Elementary School Students; Error Patterns; *Inhibition; *Observational Learning; *Psychomotor Skills; Reinforcement; Research Methodology; Task Performance

ABSTRACT

Children's self-control behavior in motor and cognitive tasks was examined in a series of two studies in which modeling and self-regulatory mechanisms were varied to assess the influence of each. In the first study, 6-, 7-, 9-, and 11-year-old children individually played a 20-trial game of 'Simon Says' (involving activation and inhibition trials) with a male model who (1) conducted the game in the traditional manner, (2) introduced the sanction, "Don't", on the inhibition trials, (3) performed an action that differed from the instructions, or (4) gave instructions only without action. Results indicated that activation latency and inhibition errors were influenced by age of the child and self-control condition. Activation errors also were affected by self-control condition, but not by age. The same motor self-control task ("Simon Says") and a cognitive task (picture arrangement) were used as performance measures in a second study with children aged 5, 7, and 9 who were assigned to one of three self-regulation conditions (external control, cognitive modeling, or self-reinforcement) or a control condition. For the motor task of "Simon Says", activation latency, activation errors, and inhibition errors decreased across age. Inhibition errors also were influenced by the specific self-regulation treatment. Solution times and accuracy scores for the cognitive self-control task improved with age and were influenced somewhat by self-regulatory mechanisms. Age similarities across self-control tasks seemed to fit the notion of a developmental function. Differential effects of the self regulatory mechanisms are discussed in the context of cognitive and behavioral competencies. (Author/MS)

Modeling and Self-Regulatory Mechanisms as Determinants of Self-Control

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Running head: Modeling and Self-Regulatory Mechanisms

Abstract

Children's self-control behavior in motor and cognitive tasks was examined in a series of two studies where modeling and self-regulatory mechanisms were varied to assess the influence of each. In the first study, 6-, 7-, 9-, and 11-year-old children individually played a 20 trial game of 'Simon Says', involving activation and inhibition trials, with a male model who conducted the game in the traditional manner, introduced the sanction, "Don't" on the inhibition trials, performed an action that differed from the instructions, or gave instructions only. Performance analyses on this motor self-control task showed that activation latency and inhibition errors were influenced by age of the child and self-control condition. Activation errors also were affected by self-control condition, but age was not a factor. The same motor self-control task ("Simon Says") and a cognitive task (picture arrangement) were used as performance measures in a second study with children ages 5-, 7-, and 9-years who were assigned to one of three self-regulation conditions--external control (use of "Don't. . .), cognitive modeling, or self-reinforcement--or a control condition. The control condition consisted of the standard version for both tasks. For the motor task of "Simon Says", activation latency, activation errors, and inhibition errors decreased across age. Inhibition errors also were influenced by the specific self-regulation treatment. Solution times and accuracy scores for the cognitive self-control task improved with age and were influenced somewhat by self-regulatory mechanisms. Age similarities across self-control tasks seemed to fit the notion of a developmental function. The differential effects

of the self-regulatory mechanisms were discussed in the context of cognitive and behavioral competencies.

Modeling and Self-Regulatory Mechanisms

as Determinants of Self-Control

A major issue in the literature on self-control (e.g., inhibiting a response that has rewarding and aversive consequences) in children concerns the age at which instructions regulate behavior. Luria (1961) contends that self-control in children appears at about age five since at this time language emerges as a controlling mechanism of behavior. According to Luria (1961), language operates as a second signalling system that has among its functions the regulation and control of behavior. Although speech is well developed in the preschool child, language is not used to regulate motor behavior at this stage of development because response inhibition in the absence of a cue or presence of an inappropriate cue is not present until speech becomes internalized and its' semantic content acquires regulatory properties. Thus verbal control of behavior (i.e., transfer of control from external stimuli such as adult directives to internal stimuli) becomes an important developmental process.

Luria's (1961) model of self control assumes that the development of self-regulation progresses through a series of stages in which behavior control changes from an external stimulus (e.g., a signal light) to verbal instructions. At stage 1 (1½ to 3 years of age) the child can respond only to direct commands of initiations such as "stamp your foot". Verbal instructions do not control termination of a response, such as in a two choice task, because the stimulus for motoric action is more powerful than the inhibiting influence of the verbal instructions. Stage 2 children (3½ to 4½ years of age) respond to the impulsive or excitatory property of a verbal instruction, but not to its semantic quality. Thus the motor component of speech is the controlling factor. But at stage 3 (4½ to 5½ years of age), the child becomes capable of responding to the semantic content of the instruction which now assumes self regulating properties.

Although Luria (1961) has been successful in demonstrating verbal control of behavior in 5-year olds using a two choice task, other attempts (e.g., Miller, Shelton, & Flavell, 1970; Wildner, 1969) have failed. Miller et al. (1970) reported that motor performance improved with age, but verbal responding by the child did not facilitate self-control. The failure of non-Soviet replications of Luria's findings have been examined by Wozniak (1973) who suggests that part of the failure to replicate can be attributed to the method of instructing the child. According to Wozniak, the self-control instructions must be simple, clear, and capable of being internalized. Further, the effectiveness of instructions may not be constant even over short periods of time. Therefore, instructions need to be repeated with each trial for children below the age of five years.

These instructional criteria were incorporated in a study by Strommen (1973) using the game of "Simon says", which is similar to Luria's bulb-pressing task, since covert performance is contingent on differential responding to the presence of absence of a verbal cue. While errors on the inhibition trials decreased significantly for the 8-year old children in Strommen's study, the 5- and 6-year olds committed more errors on the inhibition trials than would be predicted from Luria's two choice bulb-pressing task. However, in the "Simon says" game a model not only performed the task on the inhibition trials, which is similar to Luria's light signal for inhibition, but also gave a verbal instruction to perform the task, thereby increasing the difficulty of self control on the inhibition trials. As a result, inhibition errors among the younger children may have decreased if the model had given only the instruction.

Further, the use of external control mechanisms may alter the developmental progression of response inhibition reported by Luria (1961) and Strommen (1973). Specifically, the use of negative sanctions has been shown to reduce significantly response errors. Bates and Katz (1970) found that instructing 3- to 5-year olds to say "Don't push" on the inhibition trials of a telegraph key task increased response inhibition. Similar results were reported by Redd and Winston (1974) who observed that negative comments by an adult (e.g., the use of "Don't") produced greater compliance among 4-year old boys. Mild reprimands (i.e., statements using "Don't". . . and "Stop. . .") increased time on task behavior, reduced times to initiate a task behavior, and strengthened stimulus control in the Redd, Morris, and Martin (1975) study with 5-year old boys. Forehand, Roberts, Doleys, Hobbs, and Resick (1975) also reported that use of negative attention (i.e., mild verbal rebukes, followed by stares) by mothers of 4- to 6-year olds reduced noncompliance and increased task behavior. It is apparent from these findings that use of negative sanctions provides a controlling mechanism which has the potential to influence response inhibition. Although Luria (1961) has argued that the semantic content of language does not emerge as a regulator of behavior before 5 years of age, the results of the aforementioned studies indicate that mild verbal reprimands are an effective external controlling mechanism prior to this age.

Since the focus of most developmental studies of self-control has been on the changes associated with age, little attention has been given to the possible effects of instructions which conflict with a behavior. Luria (1961) has labeled the action resulting from the incongruent sequence, "echoproxia", denoting a conflict between instructions and perception. This impedence of an instruction which serves as a mediational link between the external stimulus and the overt response has been investigated by Bates and Katz (1970) who had 3-5-year olds verbalize one action while performing another. Significantly more errors were committed by the 3- and 4-year olds in the incongruent condition. Katz and Firestone (Note 2) also found that 3½ year olds made more errors in conditions where task inconsistent words were used. These findings indicate that conflictful situations increase errors of commission, thus interfering with self-controlled behavior. But Luria's concept of echoproxia has not been adequately tested, since the children in the studies cited gave the verbal instruction and performed the opposite behavior rather than receiving an instruction for one behavior while observing a person perform another. Thus the conflict in previous studies involved self instructions and behavior, rather than instructions and an observed action from an external source, which was the condition producing echoproxia in the Luria (1961) research.

Three important questions concerning self control in children emerge from the preceding review. The age progression of self-controlled behavior needs further study in a situation where modeling effects of the agent are controlled. Secondly, the effect of self-controlling mechanisms, such as verbal sanctions, for regulating behavior in children younger than six years of age needs to be considered in proposing a developmental sequence of self-control. Third, the effect of echoproxia on the developmental progression of self-control in children needs further clarification.

The aim of the first study was to provide developmental data relating to these issues.

Study No. 1

Method

Subjects. The 160 children in the study consisted of 20 males and 20 females from each of the following age groups: 6-year olds (M = 74.55 mos., SD = 4.08), 7-year olds (M = 85.60 mos., SD = 3.96), 9-year olds (M = 111.38 mos., SD = 4.94), and 11-year olds (M = 133.15 mos., SD = 4.26). All of the subjects were white, middle class children of average intelligence (IQ's from 90-110) from a suburban school. Each child was randomly assigned to one of four self-control conditions in a 4(age) x 2(sex) x 4(self-control condition) factorial design using the game of "Simon Says" as a motor performance task.

Self-control conditions. The four modified versions of the "Simon Says" game consisted of: (1) Do-Action--this condition, which could be viewed as a control, consisted of the traditional version of the game where the model gave the instructions for "Simon Says" and also performed the actions; (2) Do/Don't-Action--for this version the model presented the instructions and performed the actions, but on the inhibition trials the model preceded the specific instruction with the sanction, "Don't" (e.g., "Don't clap your hands"); (3) Conflict--in this condition the subject was instructed to do an action but the model performed a different action than that indicated by the instructions (e.g., "Simon says clap your hands", but the model stamped his foot); (4) No Model--for this version, the model gave the instruction but did not perform any of the actions.

Performance task. The performance measure consisted of a 20 trial game of "Simon Says". The game was divided into two 10-trial blocks, with five of the trials in each block designated as activation trials, where the subject was instructed to perform the action following "Simon Says". The remaining 5 trials were inhibition trials. On these trials the model gave the action instruction (e.g., "Clap your hands") in the absence of "Simon Says". The activation and inhibition trials were randomly sequenced in each of the 10 trial blocks. The dependent measures consisted of activation latency (i.e., the number of seconds which elapsed from the model's instruction to perform the action until the child began a body movement), activation error (incorrectly performing or failing to perform an action preceded by the instruction "Simon Says"), and inhibition error (performing an action on the inhibition trials where the instruction was not preceded by "Simon Says").

Procedure. Each child was taken to a mobile research trailer by a male experimenter who also served as the model. Enroute to the trailer the experimenter interacted with the subject in a warm, friendly manner. The subject was told that she/he would be playing the game of "Simon Says" in a trailer, and after the game was over a few questions would be asked. Upon entering the trailer, the child was placed in a standing position facing the experimenter, with a distance of 1.5 meters between them. The child was then given the instructions for the assigned "Simon Says" condition. Each child was told that she/he would be playing two games of "Simon Says" and was asked if he/she had played the game before. The child was told that the experimenter would give the instructions for the actions and would also perform the actions. The child was instructed to perform the action only when "I say

Simon Says." A series of five practice trials were given to each child to ensure that the instructions were understood. This practice period was followed by the first block of 10 trials. At the end of this block the instructions for the game were reviewed and the second 10-trial block was played. The subject's game performance was viewed on closed circuit TV by an observer in the adjacent room of the trailer.

At the conclusion of the game a brief questionnaire was administered to assess the child's interpretation and understanding of the instructions. The child was then given the major details of the study and requested to refrain from discussing the game or the events in the trailer with other boys and girls.

Results

Pearson correlational analyses performed on the three dependent measures revealed the following relationships: activation latency and activation error (r = .08, ns), activation latency and inhibition error (r = .28, p < .05), activation error and inhibition error (r = .18, p > .05).

A repeated measures ANOVA, using age, sex, and self-control condition as between subjects' factors and the two 10-trial blocks as a within subjects' factor, was applied to the activation latency and inhibition error scores. The means for these measures are presented in Table 1.

Activation latency. The ANOVA on latency scores indicated that length of time from model instruction to execution by the child decreased with age, $F(3,128) = 9.07$, p < .01. Mean comparisons using the Tukey HSD procedure showed that 9- and 11-year old children had shorter activation latencies than the 6- and 7-year olds (p's < .05). Apparently, the younger children were taking more time to process the information in the instructions.

Self-control condition also influenced activation latency, $F(3,128) = 4.60$, $p < .001$. Children in the Do/Don't- and Do-Action conditions executed the required actions more quickly than children in the Conflict and No Model conditions (p's $<.05$). But subjects in the No Model condition required less time than children in the Conflict condition ($p < .05$). The longer activation times in the conflict condition indicate that children were experiencing more difficulty in processing the incongruent verbal instructions and model actions.

Although sex of the child did not emerge as a significant main effect, this factor was present in a three-way interaction involving age, and self-control condition, $F(9,128) = 1.95$, $p < .05$). Simple effects analyses of this interaction showed significant differences in execution time as a result of self-control condition for 6-year old, $F(3,128) = 4.51$, $p < .01$, and 7-year old males, $F(3,128) = 2.68$, $p < .05$, but not the 9- and 11-year old males (p's $< .10$). The Tukey analyses showed that longer execution times occurred in the conflict condition ($p < .05$). Differential effects for self-control condition were present for all age groups of females F's(3,128) from 2.77 to 4.97, p's $<.05$. Comparisons of latency means at each age level indicated that 6- and 7-year olds needed longer execution times for the Conflict condition than the Do-Action or the Do/Don't-Action conditions (p's $< .05$), but not the No Model condition. The 9- and 11-year olds had higher latencies in the conflict condition than in any of the three other conditions ($p < .05$).

The trial blocks factor was not significant $F(1,128) = 3.40$, $p < .10$, although execution time decreased from Block I to Block II.

Activation errors. Since the distribution and variance of these scores did not meet the assumptions for parametric analyses, a Kruskal-Wallis one-way analysis of variance procedure with a correction for tied scores was used. The means for this measure appear in Table 1. The age analyses, for both trial blocks, were nonsignificant, $H(3)$ values of 1.83 and 4.24, p's < .10. Sex of subject was significant for trial Block I, $H(1) = 5.23$, $p < .05$. Boys made more activation errors than girls. However, the sex factor was not significant for trial Bl..k II, $H(1) = 2.08$, $p < .10$.

Activation errors were influenced by self-control condition for the 10 trials in Block I, $H(3) = 40.68$, $p < .001$, but not Block II, $H(3) = 6.90$, $p > .05$. Subsequent Mann-Whitney U tests on the Block I data for self-control condition revealed that subjects committed more errors in the Conflict condition than any of the other conditions (p's < .01). Fewer errors were made by subjects in the Do/Don't-Action conditions than in the Do-Action condition, ($p < .05$), or the No Model condition ($p < .08$).

Insert Table 1 about here

Inhibition errors. Frequency of errors on the inhibition trials varied according to age, $F(3,128) = 5.82$, $p < .001$. Comparisons with the Tukey HSD procedure indicated that the age effect resulted mostly from the greater number of errors by the 6-year olds (see Table 1) than any of the other three age groups (p's < .05 for all comparisons with 6-year olds). While sex of child was not a significant main effect ($F < 1$), this factor interacted with age, $F(3,128) = 2.97$, $p < .05$. Simple effects analyses revealed that females in the 6-year old group made more errors than their male counterparts, $F(3,128) = 4.16$, $p < .01$, but sex differences at the other age levels were not significant.

Self-control condition also influenced inhibition errors, $F(3,128) = 12.14$, $p < .0001$. Mean comparisons showed that children in the Do/Don't and No Model conditions committed fewer errors than in the Do-Action and Conflict conditions ($p < .05$). Errors were less prevalent in the Do/Don't than the No Model condition (See Table 1), but the difference was not significant ($p > .05$). Although age did not influence significantly the effectiveness of the various self-control conditions, $F(9,128) = 1.77$, $p < .08$, simple effects analyses were performed on this interaction to provide data for the three questions which were being investigated. Error differences for self-control condition were present for 6-year olds $F(3,128) = 5.17$, $p < .01$. According to the mean comparisons of treatment conditions for this age group, use of "Don't" on the inhibition trials significantly reduced errors ($p < .05$). Similar trends were present for the other age groups but the differences were not significant. The within subjects' analysis showed that trial Blocks was a significant factor for inhibition errors, $F(1,128) = 4.81$, $p < .05$. Errors decreased across trials suggesting a training effect.

Discussion

While the data show that self-control of motor behavior increases with age, more errors occurred at all ages than one would predict from the Luria (1961) model. It would appear that the age at which a child displays self-regulation of behavior is contingent on the task. Strommen (1973) has argued that the "Simon Says" game is a more stringent test of self-control than the Lurian bulb pressing task because the experimenter gives the instructions and also performs the task. Thus self-control may be present in 6-year old children if one uses a simple repetitive task such as bulb pressing, but Strommen concludes that self-regulation in more demanding tasks may not emerge until 6- or 7-years of age. The data from the Conflict condition provide further support for the contention that self-regulation is contingent on the complexity of the task. The incidence of inhibition errors for the 11-year old group, as well as the longer latencies to activation and higher activation error rates for this condition, attest to the greater self-control demands in this task. Apparently the children were experiencing difficulty in coping with the conflicting perceptual and auditory input.

Although self-control increased with age, the use of a negative sanction ("Don't") further reduced behavioral errors at all ages, demonstrating the facilitating effect of externally imposed controlling mechanisms. The use of mild reprimands such as "Don't" have been effective in controlling behavior in other contexts. This type of reprimand presumably obtain its controlling influence in part from past socialization experiences. That is, "Don't" has probably been associated with some type of punishment or other reprimand. Because of this association, the child has learned that one does not repeat a behavior when told not to. Hearing the word "Don't" has other informational value for the child. Since "Don't" means no action, the child does not have to make a decision on an appropriate action in a particular situation. That is, the child does not have to think of the rule for appropriate behavior in this situation since a verbal prohibition has been given. The shorter latencies to activation support the contention that the behavioral decision was easier when "Don't" was used.

The effects of a model on self-control were quite evident. Withdrawal of the errant model significantly reduced inhibition errors when compared to the Do-Action and the Conflict conditions. This result is congruent with the previous research on model influences on resistance to deviation (e.g., Wolf & Cheyne, 1972). The modeling effect also provides some further insight into the dynamics involved. It appears that children are attending more to the model's actions than to the verbal content since the same instructions in the absence of modeled actions resulted in fewer errors. But, why is more attention given to the model? One could argue that the model is a more salient stimulus because of the actions that are performed. That is, actions are more salient than instructions. Because of the greater salience of the modeled action the child did not listen to the instructions. Therefore, in the No Model condition, the deletion of action probably reduced errors because the child had to rely on precept not percept. The effect of modeled behavior is also evident in the activation latency analyses. Children had longer latencies to activation in the No Model than the Do-Action condition. In the absence of a modeled behavior the child had to consider an action which required more time. These results suggest that deviant behavior is more likely to occur when a deviant model is observed than when one is encouraged by another to deviate.

On the basis of these contrasts, the model seems to be an important factor in self-control. However, imposition of a mild rebuke ("Don't. . .") reduced errors even in the errant model Do-Action condition. Further, this decrement in errors was more extensive than that which occurred when the model deleted the actions. Thus it appears that sanctions are a more effective self-control mechanism than withdrawal of an errant model.

The conflict condition provides additional insight into the modeling effect. Both error rate and activation latencies were adversely affected by the incongruent sequence of conflicting instructions and behavior on the part of the model. This condition, which Luria (1961) has labeled "echoproxia", is analagous to the dilemma faced by the child who is exposed to intraparental inconsistency where the parent verbalizes one principle but behaves in accordance with another. The negative effect of inconsistency has been cited numerous times in the child literature, and Stouwie (1972) has explicated some of the dynamics involved. The data from the present study suggest that the negative effect on self-control results from the child's problem in interpreting concurrently conflicting sensory and auditory input and using this interpretation to regulate behavior. Based on the discussion of the No Model effect, it appears that in instances of conflict the child follows the model's behavior rather than the model's instructions.

Fewer inhibition errors were made by 6-year old males than their female counterparts, who had lower activation errors, although this sex difference was not present for the older children. Strommen (1973) found lower inhibition errors in her 4- and 5-year old girls, but 6-year old boys seemed to improve in self-control. According to Strommen, younger girls exhibit more self-regulation because of greater verbal skills which facilitate responding to instructions. Thus the lower activation error rate by girls in the present study seems to reflect this verbal fluency since the activation instruction contains more information than the inhibition instruction.

In general, the data suggest that self-control is influenced by age differences and sanctions, but the performance measure was a motor task. Therefore, this finding may apply to response inhibition of motor behavior only since Constantini and Hoving (1973) noted that inhibition of motor and cognitive behaviors seem to be unrelated. Self-control in the cognitive domain may not follow the age pattern of motor behavior or be influenced by the same controlling mechanisms. Because of these potential differences, a second study was conducted to assess the effects of age and self-regulation mechanisms on response inhibition in a motor and a cognitive task.

Study No. 2

Method

Subjects. The 120 white, middle class children in this study were from suburban schools. Their average IQ was 90-110. Three age groups were used: 5-year olds (*M* = 60.15 mos., *SD* = 7.78), 7-year olds (*M* = 86.15 mos., *SD* = 4.98), and 9-year olds (*M* = 111.08, *SD* = 4.10), with 20 males and 20 females in each age group. Each child was randomly assigned to one of four self-control conditions in a 3(age) x 2(sex) x 4(treatment condition) factorial design.

Self-control conditions. The four conditions consisted of: (1) Control--For the motor self-control task, the Do-Action condition in study one was used as a control. The control condition for the cognitive self-control task consisted of the standardized instructions for the picture arrangement task. (2) External Control--This treatment consisted of the Do/Don't condition from study one for the motor self-control task. Subjects in the cognitive self-control task were given the standardized instructions for the picture arrangement test followed by the admonition, "Don't hurry too fast when you put the pictures in order. Don't make a mistake". (3) Cognitive Modeling--In this condition the female model self-administered specific instructions about the task. For the motor self-control task, the model said, "What do I have to do in this game? First, I have to listen carefully to the instructions. Then, if I hear the words 'Simon Says' I must do the action. If I

don't hear the words 'Simon Says' I do not do the action". The model then performed a practice exercise while she talked about what she was doing. Following this demonstration, the child was given five practice trials with the "Simon Says" game. The child was told to talk himself/herself through each action by stating what she/he was to do. The child was further instructed to use this same procedure during the actual test trials. A similar self instruction procedure was used in the picture arrangement task. The model first asked herself what she had to do in this task. She said, "I have to put these pictures together to tell a story. First, I have to look at each picture and see what story is being told. Okay, now that I know the story, I need to find the card which shows the first picture in the story and place it here. Then, I need to find the second picture in the story and place it here. Now, I need to find the last picture in the story. Good. I have finished the story". Following this demonstration the child was given the scale scene from the WISC as a practice test. When the child had performed the cognitive modeling and correctly arranged the three card scene, he/she was reminded to talk herself/himself through the next picture constructions.
(4) <u>Self-reinforcement</u>--A modification of the self-regulation procedure developed by Kanfer and Karoly (1972) was used in this condition. The experimenter made a separate contract with the child prior to the child's performance in the motor and cognitive self-control tasks. In the contract the child promised to perform the task without making any errors. The contract was formalized by the child signing his/her name on the paper. Each child was told that she/he would receive some candy at the end of each task if no errors were committed. The second part of the condition involved self-reinforcement training. During the practice trials for each self-control

task, the child was instructed to tell himself/herself, "That's good" when no error was committed on the practice trial, or "That's bad" when an error was made. The child was further instructed to continue the use of self-reinforcement during the test trials for each task.

Performance tasks. The 20 trial game of "Simon Says", used in the first study, provided the motor self-control measure. The two 10-block trial arrangement and the scoring system were the same as that used in study one. Thus the dependent measures were the scores for latency to activation, activation error, and inhibition error.

The picture arrangement test from the WISC was used to assess cognitive self-control. All subjects were given the scale picture as a practice task. Two additional pictures provided the performance scores. The 5- and 7-year olds were administered the fight and picnic pictures which are standardized test measures for this age group. The 9-year olds were given the plank and fire scenes. Time to picture completion (in seconds) and an accuracy score, consisting of 0 or 3 for each correctly completed picture, provided the dependent measures for this task.

Procedure. The procedure for the motor self-control task--"Simon Says"--followed the same format as that used in the first study with the exception that the experimenter-model in study 2 was a female. The instructions for the cognitive self-control task (picture arrangement) were taken from the WISC Manual. The child was told that the task involved arranging picture cards so that the pictures told a story. The practice test used the scale scene. The experimenter arranged the pictures for this scene in the correct order while the child watched. The cards were then shuffled and the child was given the assigned self-control condition after which he/she was asked to construct the scale scene. In the cognitive-modeling condition, the experimenter used the self-instruct procedure while arranging the cards for the practice test. At the conclusion of the practice test the experimenter asked the child if he/she understood the task. The experimenter then administered the two test trials of the picture arrangement task with the accompanying self-control instruction. The timing and scoring for the task was done by the experimenter. The order of the two test picture arrangement scenes and the motor self-control--cognitive self-control sequence were counterbalanced.

A brief post-experimental questionnaire was used to assess the subject's interpretation of the study, after which the child was debriefed and asked to keep the activities in the trailer secret. Subsequent follow-up through child and teacher querries indicated that the subjects did not discuss the tasks with other children.

Results

Relationships between the motor and cognitive self-control measures were examined by means of a Pearson correlational analysis. The effects of age, sex, and treatment conditions on the self-control measures were assessed with a 3(age) x 2(sex) x 4(treatment condition) repeated measures analysis of variance using blocks of trials as the within subjects variable. Significant main effects were evaluated with the Tukey HSD procedure. The means for the self-control measures appear in Table 2.

Correlation of dependent measures. Intercorrelations of the motor self-control and cognitive self-control measures were significant (p's $< .05$; r's from $-.56$ to $.63$) with the exception of the latency and activation error for the motor self-control task and cognitive self-control time and accuracy score for trial 1.

Activation latency-motor self-control. Age emerged as the only between subjects factor, $F(2,96) = 26.53$, $p < .001$. Comparisons of age means revealed that the 5-year old children ($M = 10.24$) required more time ($p < .05$) to execute the "Simon Says" action than the 7-year olds ($M = 7.92$) or the 9-year olds ($M = 7.69$). Sex, self-control condition, and blocks of trials were nonsignificant (F's < 2), but sex of child and blocks were interactive factors, $F(1,96) = 4.93$, $p < .05$. Simple effects analyses indicated that males had longer latencies to activation for the first 10 trials than females, $F(1,96) = 4.96$, $p < .05$, but time to activation for the second 10 trials decreased, $F(1,96) = 4.05$, $p < .05$, for the male group.

Activation errors-motor self control. The data did not meet the assumptions for parametric analyses. Therefore, the Kruskal-Wallis analysis of variance used for this measure in the first study was applied to the error data. Mean scores for this measure appear in Table 2. Age was a significant factor for trial Block I, $\hat{H}(2) = 14.74$, $p < .01$ and Block II, $H = 5.89$, $p < .05$. Age group comparisons with the Mann-Whitney U test showed that 5-year olds made more errors than 7- or 9-year olds (p's <.01) for both trial blocks. Neither sex of subject (H values < 1) nor self-control condition (H values from .49 to 1.65, p's > .10) were significant for trial Block I or II.

Insert Table 2 about here

Inhibition errors-motor self-control. While the "0" score for the 9-year olds in the External Control condition suggests heterogeneity of variance, Kirk (1968) states that the F distribution is robust with respect to this problem if the n's are equal. Frequency of errors was influenced by age, $F(2,96) = 67.18$, $p < .01$, and self control condition, $F(3,96) = 16.12$, $p < .01$, but not sex of child ($F < 1$). Further analysis of the age effect indicated that 5-year olds ($M = 2.48$) committed more errors ($p < .05$) than 7-year olds ($M = .53$) or 9-year olds ($M = .18$). Children in the external control condition made fewer errors than their counterparts in the other three conditions ($p < .05$), (See Table 2). The highest frequency of errors occurred in the cognitive modeling condition. But the Age x Self-Control interaction, $F(6,96) = 10.01$, $p < .01$, indicates that self-control condition was influenced by age. According to the simple effects analyses of this interaction, self-control condition influenced performance for the 5-year old group only, $F(3,96) = 17.48$, $p < .01$. Examination of the treatment means for this age group showed that the least errors occurred in the external control condition ($p < .05$), although fewer errors were present in the self-reinforcement and control conditions than the cognitive modeling treatment ($p < .05$). The 7- and 9-year olds also made fewer errors in the external control condition.

Errors did not decrease significantly across blocks ($F < 1$), but blocks appeared as a factor in a three way interaction with age and sex, $F(2,96) = 3.16$, $p < .05$. Subsequent evaluation of this interaction revealed that 7- and 9-year old males and females made fewer errors on the first and second 10 trial blocks than 5-year olds (F's from 8.65 to 16.70, p's $< .01$).

Time to solution-cognitive self-control. Solution time for the picture arrangement task was influenced by age, $F(2,96) = 19.23$, $p < .01$. Longer solution times ($p < .05$) were required by 5-year olds ($M = 24.36$) than

7-year olds (M = 11.83), or 9-year olds (M = 18.58). However, 9-year olds required more time to solve the problem than 7-year olds ($p < .05$). Experience in this task seemed to influence the age effect as evident from the Age x Trial Blocks interaction, $F(2,96) = 17.50$, $p < .01$. The simple effects analyses showed that solution times decreased across age from the first to the second picture, $F(1,96) = 17.76$, $p < .01$, but age differences for each trial revealed that both 5- and 9-year olds used more time on the first picture task than the 7-year olds. However, the 5-year olds also required more time on the second picture task.

Although the self-control treatment effect only approached significance, $F(3,96) = 2.29$, $p < .08$, the need to compare treatment effects with the motor self-control task was deemed sufficient to examine mean differences. All self-control treatments increased solution time as compared with the control group (the cognitive modeling condition showed the greatest increase), but these differences were not significant (p's < .05), (See Table 2). Sex of child and all interactions were nonsignificant ($p < .10$).

Accuracy score-cognitive self-control. Accuracy on the picture arrangement was influenced by age, $F(2,96) = 38.77$, $p < .01$. Both 7-year olds (M = 2.51) and 9-year olds (M = 2.36) had higher scores ($p < .05$) than 4-year olds (M = .82). However, a significant Age x Trial Blocks interaction, $F(2,96) = 8.82$, $p < .01$, suggested that both age and experience with the task were involved. Simple effects analyses showed that higher accuracy scores were obtained by the 7- and 9-year olds on both trials.

Neither sex nor self-control treatment (F's ≤ 1) were significant, but the Age x Self-control treatment approached significance, $F(6,96) = 1.88$, $p < .09$, (Refer to Table 2). Since this relationship was examined in the motor self-control task, a simple effects analysis was deemed necessary for comparative purposes. Accuracy scores improved across age for the cognitive modeling condition, $F(2,96) = 9.88$, $p < .01$ only. Further analyses showed that the 5-year olds ($M = .15$) had lower accuracy scores ($p < .05$) than the 7-year olds ($M = 2.70$) or the 9-year olds ($M = 2.10$).

Discussion

The age differences for the motor self-control task were congruent with those reported in the previous study, in that self-control increased with age, although the error rate among 7- and 9-year olds was higher than the Luria model would predict. Further, the activation latencies decreased with age suggesting that while the older children required less time to execute a response, they also committed fewer inhibition errors. The 5-year olds required more time to execute the response, but also committed more errors. A similar response pattern appeared for the cognitive self-control task. Longer solution times for the picture arrangement task were necessary for the 5-year olds as compared to the 7- or 9-year olds, although the 9-year olds used more time than the 7-year olds. Thus, the age trend on this task was curvilinear. However, longer solution times by the 5-year olds did not result in higher accuracy scores. Unlike the 9-year olds who also used more time, the 5-year olds committed more errors. The longer information processing times by the 5-year olds did not improve self-control. Apparently the 5-year olds were not able to use the information in regulating their behavior although they seemed to process the information correctly (i.e., the children's performance on the practice trials indicated that they knew what to do in each task).

While self-control on the motor and cognitive tasks increased with age, the effectiveness of the self-control mechanisms varied with the task and age of the child. The use of the negative sanction, "Don't", increased self-control of motor behavior across the three age groups, with the greatest effect appearing among the 5-year olds. This control mechanism produced a similar effect across age groups in the first study, with the greatest change occurring for the 6-year olds. However, "Don't. . ." was not significantly more effective in controlling errors in the cognitive task. Rather, self-reinforcement seemed more effective, in an absolute sense, but age was a factor. Cognitive modeling was more effective with 7-year olds, while self-reinforcement produced better control in 9-year olds. However, none of these differences were significant. When age and self-control condition were considered, the only significant difference was that accuracy scores for the cognitive self-control task were lower for 5-year olds in the cognitive modeling condition than 7- or 9-year olds. Cognitive modeling may have impeded rather than facilitated self-control for the 5-year group, which suggests that the 5-year olds could not "talk themselves" through the cognitive task while attempting to solve it. Although Meichenbaum and Goodman (1971) found that cognitive modeling was effective in altering behavior of impulsive children on Kagan's measure of cognitive impulsivity, their youngest subjects were 6-years of age. The failure of self-control measures to significantly increase accuracy scores for the 5-year olds when compared to the control group suggests a mediation deficiency. That is, self-control mechanisms were available but the 5-year olds did not use them. In general, the self-control procedures seemed to distract the 5-year olds and thus interfered with their task performance. Evidence of this interference appeared in the inhibition error data for the motor self-control task where the error rates in the cognitive modeling and self-reinforcement conditions were higher than the control condition.

General Discussion

Overall, the data from both studies show a rather distinct age progression in self-control of motor and cognitive behavior. The 5- and 6-year olds used more time to execute a response in the self-control tasks, but they also committed more errors. This self-control pattern is analagous to the performance of children who are labeled slow-inaccurate, or impulsive, on the Kagan (1966) Matching Familiar Familiar Figures Test of conceptual tempo. Conversely, the behavior pattern for 7- to 11-year olds consisted of faster activation and solution times with lower error scores on both measures which resembles Kagan's fast-accurate category. A similar relationship between motor and cognitive self-control appeared in a study by Bates and Katz (1970) who found significant correlations (r's of -.83 with error score and .63 with latency) between scores on Luria type tasks and the Matching Familiar Figures Test.

Since motor and cognitive self-control seem to develop in a similar age-related pattern, these behaviors may fit Wohlwill's (1973) concept of a developmental function. But this developmental change does not explain why older children are more self-controlling. Mischel and Mischel (1976) have suggested that increased behavioral and cognitive competencies enable the older child to become more responsible for her/his behavior. As a result this child develops expectancies about behavioral outcomes and attaches a value to these outcomes. Further, the older child, according to Mischel and Mischel, becomes more capable of performing cognitive transformations on incoming stimuli, such attending to the relevant cues and selecting the appropriate behavior. Through the use of such cognitive operations the older child is able to exercise self-control in the presence of situational conflicts. This explanation is congruent with the findings reported in the present research. Older children had shorter activation latencies and fewer inhibition errors. They were able to quickly process the information and use its' content in controlling their actions.

Therefore, the greater effectiveness of the cognitive modeling and self-reinforcement self-control mechanisms with the older children may have occurred because these children were able to use cognitive transformations. Apparently, the younger children could not concurrently attend to the task and self introduce the regulatory mechanism. Although Masters and Santrock (1976) found that self-evaluations by 4-year olds facilitated performance, their tasks did not have an error component, and the comments which the children were urged to make included such statements as, "It's fun"; "It's difficult"; rather than self controlling responses such as those used in the cognitive modeling and self-reinforcement conditions.

However, one could argue that the length of the training period in the present study was not of sufficient duration to facilitate the young child's mastery of the cognitive modeling and self-reinforcement techniques. Continued training may have increased the effectiveness of these mechanisms. Meichenbaum and Goodman (1971) used four 30-minute training sessions for their cognitive modeling procedure, but their subjects were 7-9 years of age. Further, the results of the Constantini and Hoving (1973) study, as well as the data from the present investigation, showed that older children benefited more from self-control training than 4-5 year olds, as evidenced by the older child's increased response inhibition over trials. It would appear that cognitive and behavioral competence, not training, are the critical factors. Mischel and Mischel (1976) propose an interaction model in which these components are the product of socialization practices and cognitive maturation. That is, age related changes in self-control result from the child's social learning history and changes in the cognitive system.

Given that young children are less adept in controlling their behavior and that self-control training seems to be less effective, can the young child be assisted in self-regulation? The data from the present study indicate that use of a negative sanction (i.e., "Don't") increased behavioral control not only in 5-year olds, but older children as well, in terms of reduced errors on the motor and cognitive self-control tasks. The use of "Don't" also increased solution times on the cognitive task. Thus an external controlling mechanism (i.e., verbalization by an adult) seemed to be more effective than the self generated mechanisms, particularly with 5-year olds. This greater effectiveness may have occurred because the young child only needed to respond to an external directive for which no cognitive transformations were necessary. Cheyne (Note 1) found that telling kindergarten children who touched a forbidden toy, "That's bad", produced behavior compliance which was as high as that resulting from giving the child a reason why the behavior was inapprorpiate. Similar findings have been reported in studies comparing positive and negative statements in behavior control (e.g., Masters & Santrock, 1976; Redd & Winston, 1974). Strommen (1973) notes that the Luria model proposes a developmental progression in the young child's regulation of behavior commencing with assistance from external cues which provide important feedback. Negative feedback is a salient external cue because it connotes something is wrong, and a behavior change is necessary, as evidenced in the Masters and Santrock (1976) research. They reported that negative statements by 4-year olds decreased task persistence.

The differential effectiveness of the self-control mechanisms for the motor and cognitive behavior tasks is most apparent from the presented data. Similar findings have appeared in previous studies. Redd and Wheeler (1973) observed that instructions were more effective than reinforcement contingencies in controlling first-graders' choice behavior. Although motor and cognitive self-control may be influenced by different mechanisms, as suggested by Constantini and Hoving (1973) who found that motor response inhibition increased with age while cognitive inhibition increased with cognitive ability, Mischel and Mischel (1976) argue that the individual's self-control system must be considered. That is, self-control mechanisms are influenced by their content and age of the child. External cues, in the form of negative sanctions, seem more effective with young children because this mechanism is less cognitively demanding in terms of the transformations necessary for self-controlled behavior. However, with increasing age more cognitively demanding mechanisms increase in effectiveness of behavioral control. The apparent conclusion is that self-control is, to a large extent, cognitive control of behavior.

Finally, the external validity of the motor and cognitive tasks used in the present research needs to be considered. While one may question the appropriateness of the "Simon Says" game as a measure of motor control, Strommen (1973) has argued that the "Simon Says" game has greater external validity than the repetitive Luria bulb pressing task because the demands of the "Simon Says" game are more similar to the requests made of children in their daily regime (i.e., requests such as "don't eat with your fingers", etc.). The picture arrangement task is a cognitively demanding measure which assesses one's ability to perceive and comprehend a problem that requires anticipation and planning. Understanding sequencing is another component in this task. The demands in this task are also similar to the problems that children are presented with in school as well as social situations.

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Footnotes

Portions of this research were reported at the Fourth Biennial Southeastern Conference on Human Development, Nashville, April 1976.

The authors are deeply grateful for the cooperation of the following individuals for their assistance in obtaining children for this research project. Larry McMillan, Principal, and the teachers in Swanson School; Paul Nelson, Principal, and the teachers in Prairie Lane School; David Ankenman, Principal, and the teachers at Sunset Hills School; and Bonnie Kowloski, Director, and the teachers at Westside Early Childhood Education Center.

The authors are also indebted to Ross Parke for his suggestion of the "Simon Says" game as a motor self control task, and to Don Meichenbaum for his design suggestion of a no model condition.

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TABLE 1

Mean Scores for the Self-Control Measures on the Motor Task-Study 1

	Activation Latency[1]	Activation Error	Inhibition Error
6-year olds			
Do-Action	6.68	0	1.85
Do/Don't-Action	6.87	.05	.05
Conflict	10.19	.55	1.35
No Model	8.51	.05	.85
7-year olds			
Do-Action	7.05	0	.60
Do/Don't-Action	7.02	.05	.05
Conflict	9.65	.25	.85
No Model	8.50	0	.20
9-year olds			
Do-Action	5.71	0	.55
Do/Don't-Action	5.71	.05	.35
Conflict	8.94	.45	1.15
No Model	7.95	.05	.15
11-year olds			
Do-Action	6.06	.10	.55
Do/Don't-Action	5.30	.05	.25
Conflict	8.38	.10	.75
No Model	7.28	0	.10

[1]Latencies are expressed in seconds.

TABLE 2

Mean Scores for the Self-Control Measures on the Motor

and Cognitive Tasks-Study 2

	Motor Task			Cognitive Task	
	Activation Latency[1]	Activation Error	Inhibition Error	Solution Time[1]	Accuracy Score
5-year olds					
Control	10.50	.35	2.15	22.15	1.50
External Control	9.48	.05	.35	20.30	.90
Cognitive Modeling	10.12	.35	4.70	29.92	.15
Self Reinforcement	10.87	.25	2.75	25.07	.75
7-year olds					
Control	7.85	0	.40	8.58	2.40
External Control	7.35	0	.15	12.33	2.40
Cognitive Modeling	8.65	.10	.60	13.75	2.70
Self Reinforcement	7.85	0	.95	12.68	2.55
9-year olds					
Control	7.10	0	.20	14.28	2.10
External Control	7.75	0	0	24.95	2.55
Cognitive Modeling	7.50	0	.20	19.12	2.10
Self Reinforcement	8.40	0	.30	15.98	2.70

[1]Latencies and solution times are expressed in seconds.