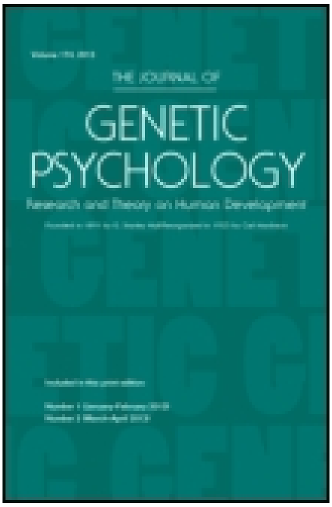

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ABSTRACT. Although prior research has shown that young children exhibit enhanced self-control when they use verbal strategies provided through adult instructions, little work has examined the role of children's spontaneous verbalizations or motor behavior as strategies for enhancing self-control. The present study examined the usefulness of spontaneous verbal and motor strategies for 39 3- and 4-year-old children's ability to exercise self-control during a resistance-to-temptation task. After a 2-min play period, participants were asked by an experimenter not to touch an attractive train set while he was out of the room. Children were videotaped during the 3-min waiting period and videos were coded for frequency and duration of touches, motor movements, and verbalizations. Results indicated that self-control was improved by using both motor and verbal strategies. Children who were unable to resist touching the forbidden toy used limited motor or verbal strategies. These findings add to the growing literature demonstrating the positive role of verbalizations on cognitive control and draw attention to motor behaviors as additional strategies used by young children to exercise self-control.

Keywords *self-control, self-talk, motor strategies, resistance-to-temptation*

The focus of the present study was on the strategies that preschool children use when confronted with a challenging resistance-to-temptation/self-control task. During the preschool years, major developments occur in children's ability to inhibit impulses and control their own behavior (Bronson, 200; Kopp, 1982). Research on children's self-control has been conducted for well over a half century. Beginning in the late 1950s, Luria (1959, 1961) published a number of

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investigations examining children's ability to exercise motor self-control based on conditional statements. Luria instructed children to squeeze a bulb in their hand while a light was illuminated and then to cease squeezing upon extinction of the light. By 2.5 years of age, children were able to demonstrate an understanding of the conditional statements by repeating them back, but were unable to successfully complete the task (i.e., they continued to squeeze after the light was extinguished). Three-year-old children, on the other hand, were able to both understand the instructions and to successfully follow them during testing. Luria suggested that although younger children understood the instructions, they only used them partially. Younger children correctly followed the instructions to begin squeezing when the light illuminated, however, they were unable to follow the second instruction to cease squeezing; they perseverated their initial motor response (squeezing the bulb) when given the signal to stop. Luria (1959, 1961) suggested that young children lack the ability to inhibit the initial prepotent pattern of response (the squeezing) in order to begin a second motor response.

Subsequent to these early studies, self-control was commonly studied using resistance-to-temptation and delay tasks. In these tasks, children are asked to inhibit a prepotent desire to engage with a stimulus (or eat a treat, in some cases) for an extended period of time (typically somewhere between 3 and 15 min). Using this paradigm, researchers began to explore the impact of strategies on young children's self-control. For example, Mischel and Patterson (1976; Patterson & Mischel, 1976) found that children who were instructed to use temptation-inhibiting (e.g., "I'm not going to play with the toys.") and reward-relevant (e.g., "I want to play with the toys, so I have to finish the work.") verbalizations were able to resist temptation better than children instructed to use general task-facilitating verbalizations (e.g., "I have to finish this work."). Similarly, Toner and Smith (1997) found that girls instructed to use verbalizations about the task rules waited longer in a delay task than girls instructed to use verbalizations about the task reward and control girls who were not told anything about their verbalizations. These early findings suggested that induced verbalizations about the task rule or task reward were beneficial strategies to improve young children's ability to inhibit their desire to engage with the forbidden object.

Researchers continue to study inhibitory control under the broad construct executive function (Diamond, 2006). A subset of this inquiry continues to focus on the impact of speech (often as verbal labels of stimuli) on self-control. For example, Müller, Zelazo, Hood, Leone, and Rohrer (2004) explored the influence of verbal labels on 3–6-year-old children's interference control by having them selectively attend to a colored card (e.g., green) underneath a colored piece of candy (e.g., red) and name the color of the card. When the 3-year-olds were instructed to verbally label the color of the card or witnessed the experimenter point to the colored card, their performance significantly improved over trials in which no labeling was used or no pointing provided. These findings suggest that strategies drawing attention to the target stimuli (colored card) help young children inhibit their desire to attend to a more salient stimuli (colored candy).

A number of other studies have also reported similar findings supporting the impact of verbalizations on preschoolers' completion of executive function (cognitive control) tasks (Fatzer & Roebers, 2013; Karbach & Kray, 2007; for an exception, see Müller, Zelazo, Lurye, & Liebermann, 2008), learning tasks (Karbach, Kray, & Hommel, 2011), and false belief tasks (Low & Simpson, 2012). More nuanced investigations have begun to explore if verbalizations during cognitive tasks are effective by direct regulatory action or by general refocus of attention to the target stimuli.

Doebel and Zelazo (2013) asked young children to verbally label the correct dimension of focus during a card sort task on some trials but to label the incorrect dimension on other trials to determine if verbal labels draw attention to task relevant information or if they act as the actual means by which regulation occurs. The researchers found that labeling the incorrect dimension did not cause the children to always select the incorrect dimension; performance, while lower than when the correct labels were used, did not have a one-to-one correspondence with the correctness of the label as would be expected if the actual labeling directly impacted performance. These findings suggest that verbal labeling might help children perform well on cognitive tasks by simply drawing attention to the stimuli. This implies that any relevant verbalization might improve performance on cognitive tasks. This position has been supported by researchers exploring children's private speech (or self-directed talk) during cognitive tasks. Children who use more task relevant speech, regardless of how much the speech is directly related to the behavioral actions needed at the time for performance, tend to have better outcomes than those who use irrelevant speech (Winsler, De León, Wallace, Carlton, & Willson-Quayle, 2003).

While research exploring the impact of verbal labeling on performance during cognitive tasks, and particularly cognitive control tasks, seems fairly robust, nearly all of these studies utilize a methodology in which the verbal labeling is induced through direct instruction, and few include an exploration of the role nonverbal or motor strategies might play in improving performance on cognitive control tasks. By inducing verbal labels through direct instruction, researchers might be over estimating the ability of preschool children. It is possible that without the experimenter providing instructions to use a verbal label, young children would not spontaneously use verbalizations or would use verbalizations with no benefit. Additionally, most research in this area does not include nonverbal strategies for improving performance. Müller et al. (2004) highlighted an exception and did include nonverbal strategies, but only does so as an external strategy (i.e., the experimenter points to the stimuli the children are to focus on) rather than a strategy executed by the children. It is possible that nonverbal behaviors work in tandem with verbal behaviors to increase young children's cognitive control. A position that is consistent with research showing that gestures are important mediators of cognitive action (Delgado, Gómez, & Sarriá, 2011).

Very few studies have been designed to explore the associations between spontaneous verbal and nonverbal behaviors and their impact on cognitive control in young children, and generally this research is limited to 2- and 3-year-old children. For example, Vaughn, Kopp, Krakow, Johnson, and Schwartz (1986) explored the spontaneous use of verbal and nonverbal strategies by 2-year-olds during a delay task. They found that 2-year-olds who delayed longer were more able to refocus their attention away from stimuli by predominantly looking or turning away from it (i.e., actively not looking at the desired object). Because these children were younger, it is possible that they had not yet developed the ability to use vocalizations to refocus their attention as newer tasks have demonstrated through verbal label induction with older preschool children. Exploring the use of spontaneous verbal and nonverbal behaviors preschoolers use to increase their cognitive control will provide information about whether these strategies are naturally available to them and whether their cognitive control is enhanced when spontaneously used rather than induced through instruction.

In the present investigation we explored preschool children's spontaneous motor movements and verbalizations as they related to following a verbal rule not to touch an attractive toy during a resistance-to-temptation task (Campbell, Pierce, March, Ewing, & Szumowski, 1994). The resistance-to-temptation methodology used in the present study should elicit a high amount of desire in preschool-age children to touch the forbidden object while they try to comply with the verbal rule not to touch the toy. The resistance-to-temptation task requires children to exercise self-control over their gross and fine motor movements to move toward the attractive (fun) forbidden object (train), which is not present in the card sorting (Zelazo, Reznick, & Piñon, 1995) or bulb-squeezing (Luria, 1959, 1961) tasks studied previously (both of which involve less fun and simple fine motor movements to execute). Successful execution of the do not touch rule during a resistance-to-temptation task involves the ability to inhibit a prepotent response to play with the toy (i.e., a basic level of self-control), while having the attractive toy left directly in front of them after a brief period of play with that toy.

The research questions addressed in the present investigation include the following: (a) Do children who do not touch the train spend a higher proportion of time *not* looking at the train compared to children who touch the train? (b) What is the effectiveness of spontaneous verbal strategies for young children's self-control when resisting the temptation of an attractive toy? (c) To what extent are spontaneous motor behaviors effective during the task? and (d) Is the combination of verbal and motor behaviors more effective than one strategy alone in increasing children's self-control? It was expected that children who use more verbal and motor strategies would demonstrate higher levels of self-control during the resistance-to-temptation task.

METHOD

Participants

Thirty-nine 3- and 4-year-old children (M age = 49.26 months, SD = 4.96 months) were recruited from an accredited university-affiliated laboratory preschool in the southeastern United States to participate in the present study. Fifteen of the participants were 3-year-olds, and 24 of the participants were 4-year-olds. More 4-year-olds were recruited due to the larger 4-year-old classroom at the preschool compared to the 3-year-old classroom. There was a similar ratio of boys (51%) and girls, who were primarily Caucasian (76.9%; 15.4% Asian or Pacific Islander; 7.7% African American). A reasonable range of family socioeconomic levels was present in the sample (Hollingshead index: range = 25–66, M = 51.8, SD = 10.6). Participants were children of university faculty and staff, university students, and community members. The average maternal age was 34 years old (SD = 4.9 years), and the average paternal age was 38 years old (SD = 5.1 years). Fathers' years of education ranged from 12 to 21 years (M = 17.08 years, SD = 3.0 years); mothers' years of education also ranged from 12 to 21 years (M = 16.5 years, SD = 2.4 years).

Procedures

Children were videotaped as they completed a resistance-to-temptation task (described subsequently) in a separate testing/meeting room at the preschool. A research assistant, naïve to the research questions of the present study, accompanied the children from their classroom to the data collection room, which contained a table, two chairs, and a large, attractive, plastic train set assembled on the floor. A high-quality, omnidirectional table microphone (sitting on the table) was used as the audio input to the video camera in order to insure quality speech recordings. The camera was mounted on a tripod approximately 12 ft away from the child facing the child's front and side as she or he began the task. Sessions took place in the early fall of two different academic years with two cohorts of children.

Task

The resistance-to-temptation task was based on the train-delay task of Campbell et al. (1994). For this task, children were individually seated in front of the train set (which had a mountain, a tunnel, tracks, and a train) and were encouraged by the experimenter to play with the train set. After 2 min, the experimenter informed the child that he had forgotten a piece of the train set (the train conductor) in the other room and was going to leave the room to get it. Before the experimenter left the room, he instructed the child not to touch the train or any piece of the train set until he came back. The specific instructions articulated by the experimenter were as follows: "Please don't touch the train; don't touch the tracks; do not touch any part of the toy until I come back." The experimenter repeated the instructions twice before leaving the room. The child was left alone in the room for the duration of 3 min (waiting period). The 3-min period began when the experimenter closed the door behind him. The video camera recorded children's behavior while waiting for the experimenter to come back. After exactly three min (180 s), the experimenter came back into the room and said, "Hey, I found it! Now, let's play with the train," and then they played with the train together. All video-recorded sessions were later coded for use and type of verbalization, fine motor movement, and gross motor movements. Only behaviors that occurred up to the time the child first touched the train, or the end of the 3-min session, whichever came first, were coded.

Verbalizations

Spontaneous verbalizations were coded for both the amount of speech and the type of speech used by each participant. A speech utterance, defined as a complete sentence, independent clause, conversational turn, or any segment of speech separated from another by three s or more, was used as the unit of analysis (Winsler, Fernyhough, McClaren, & Way, 2005). All speech utterances were categorized into one of four speech types: (a) utterances about the rules or task (i.e., not to touch); (b) descriptions about the train set; (c) speech irrelevant to the train, rules, or task; and (d) unintelligible vocalizations. Utterances about the rules or task consisted of words or phrases that reminded the child that she or he was to not play with the toy until the experimenter returned to the room (e.g., "Can't touch train."; "He said to wait 'till he comes back."). Verbalizations about the train (e.g., "That train is cool!"; "Choo-choo!") did not focus on the goal of resisting temptation but rather focused on the train set in a descriptive or playful manner. Non-task–related utterances (e.g., "This room is small."; "Go Power Rangers!") were considered to be irrelevant to train, rules, or task and could include humming, irrelevant singing (singing about the task or the rules counted in the appropriate category above), or nonsensical noises. Finally, whispers, muttering, or unclear utterances that were clearly not nonsense noise was considered unintelligible vocalizations. Prior work shows that unintelligible utterances muttered quietly by the child tend to be task-relevant and are typically classified as mature, partially internalized utterances with a self-regulatory function (Winsler et al., 2003; Winsler et al., 2005). Coding for all verbalizations during the 3-min video clips was done using the Noldus *Observer* system (Noldus Information Technology, Wageningen, The Netherlands). The number of times a speech utterance occurred (number of times) and the time that elapsed before the first instance of a speech utterance (latency to first) were calculated for all participants.

Two independent coders naïve to the research questions coded a 25% subsample of the videos to establish interrater reliability. Kappa reliability was .95 for the occurrence of speech and .78 for categorizing speech utterances into one of the speech types. Interrater discrepancies were resolved through discussions after reliability data had been entered. In those discussions, raters came to an agreement on what the behavior should be coded as, which was used in final analyses. This was the process used for all subsequent ratings as well.

Motor movements

Several categories of gross and fine motor movements were coded from the videos. Gross motor was considered to be large-body movements where the child changed or stretched across (e.g., lay down) a spatial area in the testing room. Gross motor was reliably coded into two subcategories: (a) approach or moving toward, and (b) avoid or moving away, by the same two independent raters (who established reliability for verbalizations) using the same 25% subsample. The raters reached a reliability coefficient of .99 for categorizing gross motor movements into the two mutually exclusive subcategories. Approach gross motor was any movement either from the entire body or from a limb that moved toward the train set or circumvented the train set (e.g., pointing to the train, walking toward the train, walking around the train while remaining the same distance away). Avoid gross motor was considered movement away from the train set, thus increasing the distance between the participant and the train set (e.g., walking away from the train).

Fine motor consisted of very small movements that did not span across spatial areas in the testing room, such as rocking back and forth, twitching, rapid shaking of the head, playing with hair. Three categories of fine motor behavior were coded: (a) repetitive movements, (b) physical restraint, and (c) other. Repetitive movements encompassed fine motor movements that involved the hands or feet and were repeated at least three times consecutively (e.g., tapping hand on lap, shaking leg or arm, bouncing up and down, drumming fingers on floor). Physical restraint was any behavior that constrained hands or other parts of the body (e.g., sitting on hands, covering mouth, putting hands underneath armpits). All other nonrepetitive fine motor movements that were excluded from the two above categories including those used for entertainment (e.g., playing with a handkerchief, hair, shoelace) were coded into the other fine motor movements category. The same two independent raters, coding the same 25% subsample, established reliability of .88 for the fine motor categories.

All of the gross and fine motor movements were coded up to the time the child first touched the train, or the end of the 3-min session, whichever came first. The number of times each specific motor behavior occurred (number of times), the time that elapsed before the first instance of each specific motor behavior (latency to first), and the proportion or percentage of time that a child spent engaging in each specific motor behavior across the whole observation (% of time) were calculated for each participant.

Touching

Children were coded as to whether they touched the train or any part of the train set during the 3-min waiting period. Two independent coders yielded a .84 correlation coding the amount of time and a .87 correlation coding the number of times the participants touched the train set on a 25% subsample of all participants. The number of times a child touched (number of times), the time that elapsed before the first instance of touching (latency to first), and the proportion/percentage of time that a child spent touching across the whole observation (% of time) were calculated for each participant.

Not looking

Children were coded for the amount of time not looking at the train during the waiting period up to the point of touching the train (if they touched the train) or the end of the 3-min (which ever came first). Two independent coders yielded an interrater reliability correlation of .80 for the amount of time not looking at the train set on a 25% subsample of all participants. The proportion/percentage of time that a child spent looking during the observation (% of time) up to the time the child first touched the train, or the end of the 3-min session, whichever came first, was calculated for each participant. It should be noted that children who did not spend any time engaging in one of the coded behaviors were given a value of zero to indicate no engagement and were included in the analyses.

RESULTS

Of the 39 participants, sixteen (41%) touched the train set at some point during the 3-min waiting period, and the remaining 23 children (59%) did not touch the train set during the 3-min waiting period. On average, it took children who touched a little over half a minute ($M = 35.44$ s; $SD = 45.98$) before they touched the train, and they spent only about an average of 6% of the total waiting period touching the train set. We used t-tests and chi-square analyses to determine if there were significant differences between children who touched the train (touchers) and children who did not touch the train (nontouchers) on age, gender, socioeconomic status (SES), and ethnicity. Those who touched and did not touch the train were similar in terms of age, gender, SES, and ethnicity (all analyses were nonsignificant). Therefore, these factors were not included in subsequent analyses.

Gaze Aversion

The goal of the first research question was to determine if children who did not touch the train spent a higher proportion of time not looking at the train compared to children who touched the train. The percentage of time spent not looking at the train for touchers (prior to touching) and nontouchers (for the whole 3-min waiting period) is presented in Table 1. Results from an independent *t*-test revealed no significant difference between the proportion of time touchers avoided looking at the train and the proportion of time nontouchers avoided looking at the train, $t(26.46) = 1.71$, $p = .10$.[1] Despite not being significantly different, the touchers had a higher mean proportion of time not looking at the train compared to the nontouchers.

Verbal Strategies

The second research question related to the effectiveness of spontaneous verbalizations for young children's self-control (i.e., ability not to touch the train). Table 1 provides the breakdown of verbalizations for the children who touched the train (touchers) and children who did not touch (nontouchers). Only verbalizations that occurred prior to the first touch are included in Table 1 for the touchers.

Only three of the 16 children who touched the train (19%) used any speech prior to touching (and all three used unintelligible speech), indicating that the majority of touchers did not use speech prior to touching. Of the three who talked, talking occurred early in the waiting period ($M_{latencytofirst} = 13.65$ s, $SD = 18.73$ s). Because only a few children used speech prior to touching, we cannot explore whether using speech improved the chances of not touching.

In contrast, fifteen (65%) of the 23 children who did not touch the train talked during the waiting period. Results of a within subjects ANOVA indicated that these children used significantly more unintelligible speech than any other type of speech, $F(3, 66) = 4.59$, $p < .01$. On average, nontouchers did not use speech until after about 1 min of waiting ($M_{latencytofirst} = 64.18$ s, $SD = 55.65$ s), and there was an average of only two occurrences of speech episodes per child ($M = 2.13$, $SD = 2.80$).

Motor Behavior

To address the third research question (To what extent are spontaneous motor behaviors effective for waiting during the task?), gross and fine motor behaviors were examined. Table 1 also displays the breakdown of motor behaviors for those who touched and those who did not touch the train.

Among the children who touched the train and thus did not exhibit self-control, very few used motor behavior prior to touching the train. There was only one child who engaged in each of the fine motor behaviors and the gross motor move-away behavior, while there were 10 children who engaged in the gross motor move-toward behavior, which is an action considered necessary for some children to get close enough to the train to touch it.

Among the children who avoided touching the train, many used fine motor behaviors (44% used repetitive behaviors; 26% used restraint behaviors; 78% used other fine motor behaviors) and gross motor move-away behavior (65%). Some of these children (35%) used the gross motor move-toward behavior. In raw count, nontouchers used more fine motor-other behavior ($M = 2.13$, $SD = 1.98$) than any other motor behavior. They used gross motor move-toward behavior ($M = 1.30$, $SD = 2.29$) next most, followed by fine motor repetitive ($M = 1.26$, $SD = 2.09$), followed by gross motor move-away ($M = 1.04$, $SD = 1.11$), and finally fine motor restraint the least ($M = 0.57$, $SD = 1.12$).

TABLE 1
Motor and Speech Descriptive Statistics of Participants Who Touched Versus Those Who Did Not Touch

	# of children who did behavior				*# of occurrences*				*Latency to first*				*% of time*			
	Touch		*No touch*		*Touch*		*No touch*		*Touch*		*No touch*		*Touch*		*No touch*	
	n	%	n	%	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Touch	16		23		3.25	3.15	—		35.44	45.98	—		13.59	19.14	—	
Not looking	—		—		—		—		—		—		56.45	36.62	37.91	27.70
Gross motor																
Moved toward	10	63	8	35	1.25	1.61	1.30	2.29	11.87	12.12	57.38	55.03	8.69	12.53	4.35	8.44
Moved away	1	6	14	61	0.06	0.25	1.04	1.11	6.36	—	66.71	57.07	4.56	18.26	10.58	22.86
Fine motor																
Repetitive	1	6	10	44	0.13	0.50	1.26	2.09	19.44	—	72.28	45.99	0.88	3.53	8.53	18.43
Restraint	1	6	6	26	0.06	0.25	0.57	1.12	0.60	—	42.25	42.14	0.03	0.12	5.51	19.88
Other	1	6	18	78	0.13	0.50	2.13	1.98	4.12	—	54.46	51.46	0.37	1.47	12.62	13.30
	# of children who vocalized				*# of utterances*				*Latency to first*				*Utterances/minute*			
Verbalizations	3	19	15	65	0.50	1.32	2.13	2.80	13.65	18.73	64.18	55.65	1.98	5.27	0.71	0.93
About rules	0		2	9	0		0.09	0.29	—		36.68	32.53	0		0.03	0.10
About train	0		4	17	0		0.35	0.78	—		78.33	77.14	0		0.12	0.26
Irrelevant	0		7	30	0		0.65	1.53	—		105.46	58.91	0		0.22	0.51
Unintelligible	3	19	14	61	0.50	1.32	1.04	1.22	13.65	18.73	67.68	54.82	1.98	5.27	0.35	0.41

Note. Latency statistics are limited to only those participants who engaged in the behavior (*n*s are presented in the first column of data); those who did not engage in the behavior are not included in the statistics.

TABLE 2
Number and Percentage of Participants Who Used One or a Combination of Strategies and by Those Who Did Exhibit Self-Control (Nontouchers) and Those Who Did Not (Touchers)

Strategy	*Touchers*	*Nontouchers*	*Total*
Motor and verbal	1 8% of motor and verbal users 6% of touchers	12 92% of motor and verbal users 52% of nontouchers	13
Motor only	3 25% of motor only users 19% of touchers	9 75% of motor only users 39% of nontouchers	12
Verbal only	2 50% of verbal only users 13% of touchers	2 50% of verbal only users 9% of nontouchers	4
No strategy	10 100% of no strategy users 63% of touchers	0 0% of no strategy users 0% of nontouchers	10
Total	16	23	39

Note. Significant omnibus chi square, $\chi^2(3, N = 39) = 21.75$, $p < .001$. Significant chi square for differences between frequency of children using strategies among nontouchers, $\chi^2(2, N = 23) = 6.87$, $p < .05$, such that more nontouchers use motor and verbal strategies or just motor strategies than verbal or none. Significant chi square for differences between frequency of children using strategies amongst touchers, $\chi^2(3, N = 16) = 12.50$, $p < .01$, such that more touchers use no strategy than motor, verbal, or both motor and verbal strategies.

Comparing the percent of time spent on each motor behavior, it is clear that the nontouchers spent far more time on fine motor behaviors and gross motor move-away behavior (between 5.51% and 12.62%) than on gross motor move-toward behavior (4.35%). Finally, it is worth noting that onset of motor behavior did not begin until after approximately 1 min of waiting for nontouchers suggesting that these children were able to resist touching the train for nearly 1 min without motor strategies and that the use of motor behaviors was employed as strategy during the second and third minutes.

Comparing the use of motor behaviors by the touchers and nontouchers, the fine motor behaviors and the gross motor move-away behavior were used by more nontouchers than touchers, while the gross motor move-toward behavior was used by more touchers than nontouchers.

Combination of Verbal and Motor Behaviors

Table 2 displays data that address the next research question (Is the combination of verbal and nonverbal strategies more effective than one strategy alone in increasing self-control?). Children were classified as to whether they (a) exhibited no strategy, (b) engaged in a verbal strategy, (c) engaged in a motor strategy, or (d) engaged in both a motor and a verbal strategy. The number and percentage of children who used verbal, motor, both, or neither strategy are displayed for children who touched the train (touchers) and children who did not touch the train (nontouchers). Children who did not touch the train used either both a verbal and motor strategy or just a motor or verbal strategy, and none failed to use a strategy. Among those who touched, 63% did not use any strategy. Further, all of the children who did not use a strategy touched the train before the end of the waiting period. Children who used a combination of both a motor and a verbal strategy had the lowest probability of touching the train (0.08), followed by children who only used a motor strategy (0.25), followed by children who only used a verbal strategy (0.50).

An omnibus chi-square analysis was conducted to determine if there was an association between these categories of strategy use and whether or not the children touched the train. Results were significant, $\chi^2(3, N = 39) = 21.75$, $p < .001$, indicating differences between the types of strategies used by children who did and did not touch the train. Next, a logistic regression analysis was conducted to explore the independent impact gross motor, fine motor, and verbal strategy use have on touching behavior. Results were significant, $\chi^2(3, N = 39) = 31.31$, $p < .001$, with all three independent variables explaining significant variance in touching behavior (fine motor strategy, $B = –2.76$, $SE = 1.36$, $e^B = .062$, $p < .05$; gross motor strategy, $B = –2.97$, $SE = 1.48$, $e^B = .052$, $p < .05$; verbal strategy, $B = –3.48$, $SE = 1.30$, $e^B = .031$, $p < .01$).

DISCUSSION

The goals of the present study were to explore the motor and verbal strategies that children use during a resistance-to-temptation task to help them refrain from touching an attractive train set during a 3-min waiting period. The study extends the present literature by showing relations between spontaneous (rather than instructed) verbal strategies and children's self-control, and by the inclusion on nonverbal/motor strategies in addition to verbal strategies. It was hypothesized that children who were more successful at demonstrating self-control during this task (i.e., those who did not touch the train) would use more motor or verbal strategies to help themselves retain focus on the rule to not touch the train.

The results supported this hypothesis. Children who successfully waited the 3-min period without touching the train (nontouchers) were more likely to use verbalizations, particularly unintelligible verbalizations, gross motor behaviors that distanced themselves from the train set, and fine motor behaviors (of all types) compared to children who touched the train (touchers) during the 3-min period. Indeed, a majority of nontouchers used at least one unintelligible verbalization, at least one gross motor movement away from the train, and at least one "other" fine motor movement, while a majority of touchers used at least one gross motor movement toward the train (presumably on his or her way to touching the train). Looking away from the train was not a strategy associated with increased self-control.

Interestingly, both motor and verbal behaviors used by nontouchers were more likely to occur after about 1 min on average. One interpretation of this is that these strategies may not have been necessary until the waiting became harder, and harder as the wait time increased. Implicit in this interpretation is that no overt strategy was necessary to support self-control early in the wait period. It is also possible that the increase in motor and verbal behavior during the latter part of the wait period reflects an increase in boredom from waiting. If the reason for increased use of verbal and motor strategies is related to boredom, we would expect those behaviors to be playful and grand rather than minute and subtle. For instance, a bored child may sing or talk aloud to him- or herself about task-irrelevant things rather than murmur and mutter unintelligibly to himself. While most of the nontouchers (70%) did not engage in task-irrelevant speech, 30%

did, which might lend support that a few of the children might have been experiencing boredom rather than, or in addition to, supporting their self-control.

The means by which the use of these strategies improves self-control is also an important consideration. An explanation based on findings from research exploring verbal labeling and cognitive control would be that these strategies help children refocus their attention back to the rule to not touch the train, resulting in more self-control. Another explanation is that these strategies merely distracted the children from their desire to play with the train set. The results of the present study yielded differences in the number of nontouching children who displayed behaviors that seemed to divert their attention away from the train (i.e., moving away from the train, engaging in fine motor activity, murmuring or muttering unintelligibly), which might support the distraction explanation. However, as previously noted, it seems like more grand behaviors, such as singing and dancing rather than murmuring and engaging in fine motor behavior, would be more effective behaviors for distraction away from an attractive toy. Muttering and murmuring unintelligibly in more consistent with behavior seen when young children are engaged in challenging cognitive tasks. Indeed, muttering and murmuring unintelligibly has been found by a number of researchers to be a more mature and self-regulatory form of self-directed speech that reflects use of internalized speech (Winsler, 2009). Therefore, it seems more likely that the use of these partially internalized vocalizations reflect attention refocusing through verbal mediation rather than distraction.

Of course, a child can use one of many strategies to help him or her exercise self-control, which was clearly the case among some of the children. One third of the children in the present study used both a motor strategy (gross motor movement away from the train or any of the fine motor movements) and a verbal strategy (verbalizations about the rules or the train and unintelligible verbalizations). Among the children who used both a motor and verbal strategy, the vast majority (all but one child) exhibited self-control and did not touch the train. This suggests that the use of both motor and verbal strategies lowers the probability of preschool children breaking the rules during a resistance-to-temptation task.

Further, all of the children who were successful at the task (i.e., did not touch the train) used some form of motor or verbal strategy or a combination of both. Comparatively, the majority, 10 of the 16 children who touched the train (63%), did not use any motor or verbal strategy. Indeed, only three touchers used verbalizations prior to touching. With so few talking prior to touching, it is fairly safe to conclude that using speech likely did not result in touching. These data suggest that the use of a strategy is effective at increasing self-control and that the combinatory effect of multiple types of strategies is likely optimal. These findings are consistent with Müller et al. (2004), who showed that both induced verbal strategies and external nonverbal strategies (i.e., pointing by the experimenter) were useful tools for aiding preschool children's action control during an executive functioning task. Müller et al. (2004) suggested that the use of these strategies reinforce children's attention back to the rules of the task. The idea of refocusing attention via verbal and nonverbal strategies might explain why both verbal and motor strategies helped the children in the present study with resisting the temptation to touch and play with the train set; the motor movements and verbalizations helped refocus their attention to the do not touch rule.

The findings from this study may also have implications for intervention and practice. The finding that motor and verbal strategies were helpful in increasing children's behavioral control supports interventions based on increasing children's use of such behaviors when self-control is the goal. For example, a number of studies have examined the effectiveness of using self-talk for controlling behavior (Callicott & Park, 2003; Diaz & Berk, 1995; Diaz, Winsler, Atencio,

& Harbers, 1992). Perhaps the effectiveness of using self-verbalizations for controlling behavior would be more effective if paired with a corresponding motor behavior.

NOTE

1. Levene's test for equality of variances was significant, $F(1, 37) = 5.86$, $p < .05$. Therefore, the *t*-test results presented assume nonequivalent variance and are adjusted accordingly.

AUTHOR NOTES

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