Inhibitory Control and Internal State Language in 30-Month-Old Toddlers

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Abstract

Inhibitory control, an integral aspect of executive function, specifically refers to the ability to inhibit a natural response in favor of a novel response. Internal state language refers to words that are self-referent (for example, hungry, thirsty, love, sleepy, look, see, and watch). Inhibitory control and internal state language undergo rapid development in the preschool years, and previous research suggests that the development of these processes is related. Bellagamba and colleagues (2014) found that inhibitory control is significantly related to internal state words in 24 month old children. It is hypothesized that children with larger internal state vocabularies will exhibit higher self-regulation through complex distraction behaviors during a delay task than those with smaller internal state vocabularies. Behavioral data was collected during lab visits where seventy five 30-month-old children completed various tasks while one caretaker filled out a language measurement, the MacArthur Bates Communicative Development Inventories (MCDI) Words and Sentences (Fenson et al, 1994). Analyses revealed trends that distraction behaviors are related to internal state language, such that children with better distraction tactics tended to have larger internal state language vocabularies. This relationship may have broader applications for the development of early interventions for Autism Spectrum Disorder.

Inhibitory Control and Internal State Language in 30-Month-Old Toddlers

There is not much research available concerning the development of two and a half year olds, primarily because designing tasks to accurately measure constructs of interest and determining the validity and reliability of such tests can be difficult. Before a certain age, children are unable to communicate effectively because these processes have not yet been fully developed. By understanding the developmental course that different processes take naturally, we can more easily identify when these processes are disrupted. This study aims to determine the relationship between internal state language and inhibitory control, which is an integral aspect of executive function.

Executive function refers to the higher order cognitive control and self-regulatory processes such as working memory, inhibitory control, and planning. Inhibitory control refers to the ability to monitor and control conscious thought and thus be able to inhibit or delay a prepotent response. Development of executive control undergoes rapid development during the preschool years (Bellagmba et al., 2014; Carlson & Moses, 2001). Evidence for such development is supported by neuroimaging techniques, which show rapid development of the frontal lobes during this period (Carlson & Moses, 2001; Morasch & Bell, 2011).

In a study investigating the relationship of inhibitory control and Theory of Mind, Carlson and Moses (2001) argued that executive function might affect both the emergence and expression of Theory of Mind. While it is impossible to distinguish the directionality of this relationship given that it is correlational evidence, it would seem that without proper executive control, one would not be able to express one's understanding of Theory of Mind adequately. These two abilities build off each other, constantly influencing the other's development.

Inhibitory control can be tested through both conflict and delay based tasks. Carlson and Moses (2001) developed an extensive battery of tasks assessing both Theory of Mind and inhibitory control (looking at both conflict and delay tasks). They found that both conflict and delay measures of inhibitory control were significantly related to Theory of Mind, but that conflict tasks exhibited a stronger relationship when controlling for delay tasks than delay tasks did when controlling for conflict tasks. The relationship between inhibitory control and Theory of Mind was significant even after controlling for age, gender, verbal ability, and number of siblings (Carlson & Moses, 2001).

In addition to great advances in the development of executive control, toddlers are also expanding their vocabulary exponentially. One aspect of language that is particularly relevant over the course of development in the third year of life is internal state language. Internal state language is the ability to refer to one's internal states, and has been considered an important indicator of Theory of Mind. These words can be separated into categories that represent different aspects of internal state such as perception (e.g. look, see, watch), physiology (e.g. hungry, sleep, thirsty), emotion (e.g. happy, sad, smile), volition (e.g. want, need, can), cognition (e.g. think, pretend, dream), and moral judgement and obligation (e.g. good, bad, naughty) (Bretherton & Beeghly, 1982). These internal state words provide a measurable way to determine the extent and complexity of how children understand of Theory of Mind. Bretherton and Beeghly (1982) have shown that the expression of internal state words begins late in the second year of life and burgeons in the third.

This relationship between inhibitory control and language has been shown in a number of studies. In a study investigating inhibitory control and Theory of Mind in 3 and 4 year-olds, Carlson and Moses (2001), found that 10 inhibitory control tasks were significantly related to

verbal ability, as assessed by the Peabody Picture Vocabulary Test-Revised (PPVT-R). Wolf and Bell (2004; 2007) demonstrated a link between language and working memory and inhibitory control (WMIC), such that children with higher vocabulary scores also had higher working memory and inhibitory control scores. Bellagamba, Laghi, Lonigro, Pace, and Longobardi (2014) found a significant relationship between inhibitory control and internal state language. They found that a conflict task, but not a delay task, was significantly related to internal state language.

Bellagamba and colleagues (2014) used a response inhibition task and a delay of gratification task to investigate the relationship between conflict and delay inhibitory control measures. To address conflict, toddlers completed a reverse categorization task in which they sorted large and small blocks into large and small buckets. The researchers then proposed a 'silly' game, in which the large blocks went in the small bucket and the small blocks went in the large bucket. The delay task (gift delay) involved presenting the children with a shiny present while telling them that this was their thank you gift for participating in the study, but the experimenter forgot the bow for the present! Children were told to wait to open the present until the researcher came back with the bow. They found that at 24 months, a child's performance on the conflict task, but not delay task, was significantly related to internal state vocabulary. The researchers argue that this was the case because conflict and delay tasks pose different representational demands on the child during inhibition. Conflict tasks are more rule based, requiring abstract attention and inhibition, whereas delay tasks largely involve inhibiting a contextual and reward based response (Bellagamba et al., 2014). These may represent two different processes, which are collectively called inhibitory control.

In order to measure inhibitory control, the present study utilizes a slight variation on the Snack Delay Task used by Vaughn van Hecke and colleagues (2011). Vaughn van Hecke's (2011) experiment assessed toddlers at 36-months and performed a self-regulation snack delay task. In this task, the assessor showed the child a bag of fruit snacks, a clear plastic cup, and a bell. The assessor then explained that the child would have to wait for the bell to ring to retrieve the fruit snack from under the clear cup. There were six trials, lasting 5s, 10s, 0s, 20s, 0s, and 30s. Trials were coded on the basis of prompts, anticipation, delay, and distraction (Vaughan Van Hecke et al., 2011).

The present study alters the snack delay by substituting a sticker for the snack. This alteration eliminates the confounding variable of whether children have different levels of food-related motivation by replacing the snack with a neutral sticker. This delayed-response task combines the conflict and delay concepts by being both rule based (conflict) by waiting for the assessor to ring a bell and involving a delay before retrieving the sticker immediately. Assessing inhibitory control as such will determine whether the Sticker Delay task is in fact a combination of conflict and delay measures, or if it is solely one or the other. The distraction behaviors will assess the conflict aspect of the task because the child will have to cope with the rules of the sticker task and distractions act as an externalization of inhibiting the natural response of retrieving the sticker immediately. Prompts and anticipation will assess the delay aspect of the task because they are measures directly related to regulating oneself in a delay situation.

One commonly used language measure for toddlers is the MacArthur Bates Communicative Development Inventories (MCDI) Words and Sentences. This measures the productive vocabulary of 16-30 month old children, and has been extensively tested and proven to be a reliable and valid measure (Fenson et al, 1994). Bellagamba and colleagues (2014) used

the Internal State Language Questionnaire (ISLQ) (Breatherton & Beeghly, 1982) to assess

internal state words in 24 month children. Because the present study did not implement this

measure, words that were present in both the ISLQ and the MCDI were selected from the MCDI

for analyses. The MCDI contained 43 of the 78 words included in the ISLQ; these words can be

found in Table 1.

Based on previous research on inhibitory control and internal state language, it is

hypothesized that toddlers with larger internal state vocabulary will employ the use of more

complex distraction behaviors during the Sticker Delay task than those who have smaller internal

state vocabulary. In addition, children with a better understanding of internal state language will

use fewer prompts to the assessor to ring the bell as well as show less anticipatory behavior over

the course of each trial. By combining the conflict and delay aspects of inhibitory control, the

relationship between these two types of inhibitory control can be assessed and can reveal if they

should be addressed as different constructs. Comparing internal state language to the reverse

categorization task will (1) assess the relationship between internal state language and inhibitory

control at 30 months, (2) address Bellagamba and colleagues' (2014) results in relation to the

reverse categorization to determine if their results are repeatable, and (3) serve as a comparison

to the sticker task to determine if it is a valid measure of inhibitory control as both a conflict and

delay based task.

By determining this relationship and the strength of this association at 30 months, there

could be important implications in identifying atypical development earlier than is presently

possible. One possible application could be to identify early markers of autism, which has been

shown to include impairment in internal state language and inhibitory. Children with autism

show deficits in inhibitory control both behaviorally (Christ, Holt, White, & Green, 2007) and

neurally, through atypical activation and decreased synchrony when compared to healthy controls (Kana, Keller, Minshew, & Just, 2007). Children with autism also have deficits in Theory of Mind, which extends to limited abilities to talk about their internal states (Bird, Cleave, Curia, & Dunleavy, 2008). Bird and colleagues (2008) found that parents of children with autism tended to use less internal state language than parents of typically developing children. Siller, Swanson, Serlin, and Teachworth, (2013) also identified fewer instances of internal state references when reading a story book when compared to typically developing children. These data coupled with deficiencies in inhibitory control could provide a possible area for intervention. Identifying this link could allow parents to seek interventions sooner and therefore possibly lessen the severity of this developmental disorder.

Methods

Participants

The participants consisted of 75 children (37 female; 49.3%), recruited within 3 weeks of the date they turned 30 months (M=30.46 months, SD=0.20, Min=29.77, Max=30.73). Participants were selected from a pool of individuals who previously participated in the First Year Inventory (FYI) and indicated that they would be interested in participating in other research opportunities (Reznick et al., 2007). In addition, parents were only contacted if their zip code indicated that they lived within a 25 mile radius of the test location. A total of 15 participants were excluded: experimenter error (*n=2*), recording equipment malfunction (*n=6*), incomplete MCDI data (*n=2*), or because the child did not understand the sticker task (*n=5*). Participants were 86.67% Caucasian. Parents of the participants signed an informed consent letter outlining the purpose of the study.

Measures

Parent Report Language Measure: In order to obtain a measure of expressive vocabulary, parents filled out the MacArhtur-Bates Communicative Development Inventories (MCDI) Words and Sentences (Fenson et al., 1994) during the lab session while their child performed tasks with the experimenter. Parents indicated whether their child knew a word by checking the box beside it. Internal state words, as chosen by inclusion in the Internal State Language Questionnaires (ISLQ) (Bretherton & Beeghly, 1982), were picked out of the MCDI and summed for analyses. There was a total of 43 words in the MCDI that corresponded with the ISLQ (see Table 1 for a list of these words).

Reverse Categorization task: This task, based on the Carlson, Mandell, and Williams' (2001) task involving different sized blocks and buckets, involved children sorting different colored blocks into different colored buckets to assess response inhibition (a conflict aspect of inhibitory control). The task required children to sort red and blue blocks into their same colored red or blue bucket in the first trial, and the switch categorizations by sorting the blocks into the incongruently colored bucket. The experimenter demonstrated how to play by placing one red block in the red bucket ("These ones go in here") and one blue block in the blue bucket ("and these ones go in here"), while avoiding using color words, and asked the child to sort the remaining blocks ("Can you help me with the rest?"). If the child incorrectly sorted a block, the experimenter picked the block up and asked the child which bucket it went in until the child sorted it correctly. After completing the matching color trial, children were told they were going to play a "silly" game. In the second non-matching color trial, children were shown that the red blocks went in the blue bucket and the blue blocks went in the red bucket (with one block each demonstrated again). Children were again corrected if they placed a block in the wrong (in this

case, same colored) bucket. The task was coded for the number of correctly sorted blocks each

trial, the errors committed by the child in each trial, the number of self-corrections observed in

each trial, and the number of perseverations observed in each trial. Errors were only recorded if

the experimenter had to correct the child's sorting and gave him/her to opportunity to re-sort the

block correctly. Perseverations were recorded if the child continued to make the same error with

the same block. Self-corrections were recorded if a child committed an error but corrected

his/her mistake before the experimenter corrected the child. Reliability was determined by a

second coder assessing 20% of the videos independently and then comparing the two codes.

Consistency between coders was 100% for all variables.

Sticker Delay task: This task was based on the Snack-Delay task described by Vaughn

van Hecke and colleagues (2011) and is a measure of inhibitory control. In this task, the

experimenter and child sat facing each other across a small table with a bell, a clear cup, and

stickers displayed between them. The experimenter introduced the task by telling the child that

he/she was going to win some stickers. After showing the stickers to the child, the experimenter

placed a sticker under the clear cup and told the child that in order to win the sticker, he/she had

to wait for the experimenter to ring the bell before the child could retrieve the sticker from

underneath the cup. ("When I ring my bell, you can pick up the cup, and get the sticker!") One

to two practice trials were conducted in order to be sure the children understood the game. The

task consisted of 7 trials, with a set progression of trials lasting 5, 10, 0, 20, 0, 30, and 45

seconds each. The task was coded based on the number of prompts from the child for the

experimenter to ring the bell, the level of anticipatory behaviors shown, the highest level of

distraction employed, the total delay time waited for the sticker, and whether the child completed

all trials successfully. The zero second trials were not coded. Table 2 provides detailed

descriptions of each variable. Reliability was determined based on correlations between two independent coders for 20% of participants (Prompts=0.93, Anticipation=0.84, Distraction=0.97, Delay=0.99, and Completed Trials=1.00). Absolute differences between the two coders for each variable were also calculated, such that the numbers presented show the average discrepancies between the codes. (Prompts=1.75, Anticipation=0.58, Distraction=1.08, Delay=0.33, and Completed Trials=0)

Procedure

Each participant began the assessment accompanied by one parent in a quiet room with age-appropriate toys laid out on the floor. The parent and child played together for 8 minutes; this served as a 'warm-up' to the space. Children completed a variety of tasks with the experimenter and/or parent, including the reverse categorization task and the sticker task, both explained by the experimenter. While the child was engaged in games with the experimenter, the parent was seated behind the experimenter in a chair and was instructed to fill out the MCDI. Parents were also instructed to not participate or help their child during any task by prompting them, using color or shape words, or providing instructions.

Results

To investigate the relationship between inhibitory control and internal state language, data were analyzed using Pearson correlations and generalized linear models. Inhibitory control was assessed by the sticker task and the reverse categorization task. Internal state language was assessed by results from the MCDI. The sticker task included the variables prompts per second, average level anticipation, average level distraction, total delay, and completed trial average. Variables assessed for the reverse categorization task included errors post-switch and self-corrections post-switch. Task related variables were analyzed in comparison to the sum of

internal state words. Table 3 reports the means, standard deviations, and minimum and maximum values of all continuous variables analyzed.

Pearson correlations revealed significant differences in children's behaviors during the sticker task, but not the reverse categorization task (results in Table 4). The average level distraction was negatively correlated with the number of prompts per second, $r(60)= -0.72$, $p<0.0001$. Children who showed more prompts per second exhibited lower levels of distraction than did children with fewer prompts per second. Average level distraction was also significantly positively correlated with total delay, $r(60)= 0.60$, $p<0.0001$ and the completed trial average, $r(60)= 0.60$, $p<0.0001$. Children who did not wait the full delay time showed lower levels of distraction than did children who waited longer. Total delay was significantly negatively correlated with prompts per second, $r(60)= -0.39$, $p<0.0001$ and the completed trial average, $r(60)= -0.51$, $p<0.0001$. Children who exhibited more prompts per second were less likely to wait the entire delay time and complete all trials. The average level of anticipation was not significantly correlated with prompts per second, average level distraction, total delay, or completed trial average.

Pearson correlations also revealed that the average level of distraction had a trending correlation with the sum of internal state words, $r(59)= 0.21$, $p=0.10$). The sum of internal state words was not correlated with prompts per second, average level anticipation, total delay, or completed trial average.

The continuous inhibitory control variables of both tasks were grouped based on the median or quartiles of each distribution. General linear models were conducted to determine if there was a difference between these groups and the sum of internal state words. Average level distraction behavior was grouped into three groups, such that group 1 consisted of the lower

quartile (low level distraction behaviors), group 2 consisted of the second and third quartiles (middle level distraction behaviors), and group 3 consisted of the upper quartile (high level distraction behaviors). This model revealed a moderately significant relationship with the sum of internal state words, $F(2,56)=2.99$, $p=0.058$, where average level of distraction scores increased as the sum of internal state words increased. These results, displayed in Figure 1, show that larger sums of internal state words are related to higher average levels of distraction. Figure 1 also shows the variability of each group, which decreases with each group (group1> group2>group3). Children in group 3 had the highest average levels of distraction and had larger internal state vocabularies ($n=18$, $M=39.25$, $SD=5.79$), followed by children in group 2 ($n=25$, $M=38.36$, $SD=5.39$). Group 1 showed that children with lower average levels of distraction had the lowest average levels of distraction and smallest internal state word vocabularies ($n=16$, $M=34.05$, $SD=9.08$). There was no significant relationship between high/low groups in prompts per second, average level of anticipation, total delay, or the completed trial average and the sum of internal state words.

Analyses concerning the reverse categorization task revealed a marginally significant correlation between the number of self-corrects post-switch and the sum of internal state words, $r(56)= 0.26$, $p=0.053$. Children with more self-corrects tended to have larger internal state word vocabularies than did children with fewer self-corrects. The sum of internal state words was also trending with the high/low groups of self corrects, $F(2,56)=3.42$, $p=0.069$ (Figure 2). Children in the high self-correct group tended to have larger internal state vocabularies ($n=28$, $M=39.10$, $SD=5.32$) than did children in the low self-correct group ($n= 30$, $M=35.73$, $SD=8.17$). The number of errors post-switch was not significantly related to the sum of internal state words.

Further analyses addressing effects of gender revealed trends related to the average level of distraction behavior exhibited, $F(1,58)=2.72$, $p=0.10$ (Figure 3). Trends show that females exhibited higher level distraction behaviors ($n=30$, $M=1.61$, $SD=1.01$) than did boys ($n=30$, $M=1.16$, $SD=1.11$). There were also marginal trends regarding gender differences with regards to total delay and the completed trial average, $F(1,58)=2.62$, $p=0.11$; $F(1,58)=2.54$, $p=0.12$. Females tended to have higher delay times ($n=30$, $M=96.1$ seconds, $SD=21.04$) and a higher completed trial average ($n=30$, $M=0.83$, $SD=0.26$), than did boys ($n=30$, $M=85.17$ seconds, $SD=30.38$; $n=30$, $M=0.71$, $SD=0.32$). There was not a significant relationship between gender and the sum of internal state words, with either of the reverse categorization variables, or between prompts per second, average level of anticipation, total delay, or the completed trial average.

Discussion

These results partially support the initial hypotheses in that children with larger internal state word vocabularies tended to employ higher level distraction behaviors during the Sticker Delay task. There was no relationship with internal state language and prompts or anticipatory behaviors. This pattern suggests that distraction behaviors may be related to language development, but that prompts and anticipatory behaviors are not. The sum of internal state words was also mildly correlated with the number of self-corrects post-switch in the reverse categorization task. These results support Bellagamba and colleagues' (2014) findings linking this conflict-based measure of inhibitory control with internal state language.

The present findings suggest that there may be two separate subcategories of inhibitory control. Although this study did not explicitly address the delay construct of inhibitory control, such as the gift-delay task used in Bellagamba (2014) and colleagues' design, one could argue

that the prompts and anticipation from the Sticker Delay task were related to this delay construct. This interpretation suggests that there are different components of inhibitory control and that these components must be separated in further studies. Addressing inhibitory control as a single construct could mask true relationships between these different aspects of inhibitory control and other processes. Based on the present study, as well as the work of Bellagamba and colleagues (2014), clarification is needed to create separate subcategories of inhibitory control such that one subcategory is connected to conflict-based inhibition and the other category is related to delay-based inhibition.

With regards to measuring language, the MCDI is not designed to be a measure of internal state language, and therefore may not have provided an accurate representation of participant's knowledge of such words, which limits conclusions. The comparison to the reverse-categorization task further supports this argument, because, if the MCDI had reliably represented the internal state language abilities of the toddlers, there should have been a stronger relationship than was observed. Further studies should assess internal state language with a reliable and valid test such that the relationship seen as a trend in the present study can be measured more accurately.

Despite this unreliability of the MCDI for measuring internal state language, the trends observed here suggest a true relationship between distraction behaviors and internal state language. Children with better understanding of their internal states may be better able to recognize what waiting feels like and adequately respond by distracting. Anticipation was not related to internal state language or any other variable observed in any of the tasks. Therefore, anticipation is probably not related to inhibitory control.

Prompts were related to the total delay time and completed trial average, such that children who prompted the assessor more also tended to end trials preemptively and therefore not wait the entire delay. Prompts were also inversely related to distraction behaviors; children who prompted frequently also exhibited low levels of distraction and vice versa. This relationship, with regard to the different constructs of inhibitory control (conflict or delay), could explain the differences in relationship to internal state language. Perhaps prompting behaviors and delay of gratification tasks are mediated by some other developmental process.

Additionally, number of self-corrects post-switch of the reverse categorization task had a marginal relationship with the sum of internal state words. A limitation of interpreting this relationship between the sum of internal state words and the number of self-corrects observed post-switch is that children who completed the task perfectly and children who had errors but did not self-correct both received scores of zero. A better way to approach this would be to look at three groups: (1) children who made errors and did not self-correct (2) children who self-corrected, and (3) children who made no mistakes at all. Observed trends would support predictions that children who committed errors and did not self-correct would have the smallest internal state word vocabulary of the three proposed groups.

Finally, analyses addressing gender relationships revealed that females tended to employ higher level distraction behaviors and waited longer during trials on average than did boys. Thus supports research suggesting that women are better at delay of gratification tasks than men across the life span (Silverman, 2003). Assessing younger children could reveal if this advantage is consistent throughout development, or if males just experience a lag and catch up to females.

Future studies could address the underlying mechanism related to individual differences in behaviors related to prompting versus distraction in delay-related inhibitory control tasks.

Identifying the distinction between these two subcategories of inhibitory control could shed light on the relationship of other processes in development. The findings that support a trend between internal state language and distraction behavior could be extended to both older and younger children to better understand how these two constructs are related. Additionally, a longitudinal investigation and more diverse sample may provide a better picture of this relationship.

Determining the relationship between inhibitory control and internal state language could have important implications for new autism interventions. Bird and colleagues (2008), found that parents of children with autism used less internal state language than parents of typically developing children. Perhaps parents could emphasize these internal state words with their children. This could lessen the severity of the disorder.

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Table 1:

Internal State Words from the MacArthur Bates Communicative Development Inventories (MCDI)

Internal State Words		
See	Wake up	Smile
Look	Sick	Cry
Watch	Happy	Want
Hear	Better	Need
Listen	Good	Have to (ability)
Taste	Nice	Can (volition)
Cold	Like	Hard (difficulty)
Hot	Love	Think
Hurt	Sad	Pretend
Hungry	Mad	Good (moral)
Thirsty	Scared	Bad (moral)
Sleepy	Dirty	Naughty
Sleep	Yucky	Let
Asleep	Bad (feeling)	Have to (need to)
Tired	Hug	Can (permission)
Awake	Kiss	

Note. Repetitions based on different meaning (e.g. bad feeling vs. bad moral) were only included once because the MCDI did not make the distinction between the nuances of definitions.

Table 2:

*Sticker Task Variable Descriptions*_____

Variable	Description
1. Prompts	Average number of times the child pointed at/reached for the bell, touched/rang the bell, touched or moved near the assessor, or said something to move the trial forward such as: "Ring it," "Now," "I'm ready," or "OK."
2. Anticipation	Children received one score for each trial indicating the highest level of anticipation observed. A final score of "Average Level Anticipation" was recorded by summing the levels of anticipation and dividing by the 5 trials. Levels of anticipation are as follows: 0=no anticipation, 1=gaze shifts between bell/cup/assessor for <3s, 2=child reaches for, points to, holds, picks up, or plays with cup; looks at cup for >3s; vocalization about the sticker/waiting/bell/cup (but not a prompt), 3=child points to or touches sticker but does not pick sticker up/end trial.
3. Distraction	Children received one score for each trial indicating the highest level of distraction observed. A final score of "Average Level Distraction" was recorded by summing the levels of distraction and dividing by the 5 trials. Levels of distraction are as follows: 0=no distraction, 1=any gaze shift around the room/at parent/under table/out window,* 2=child makes sticker unrelated comment to assessor or parent,* 3=child engages in any of the following behaviors >3s: looks around the room, looks at/stares at/fixates on assessor, runs around room, physically adjusts self on chair, fidgets with body/chair (sit/stand/tip/bounces), plays with hands/face, goes over to parent, makes silly facial expressions to parent or assessor,* 4=child engages in level 3 distraction for greater than ½ the time of the trial (ex: 15s of 30s trial).
4. Total Delay	The total number of seconds the child waits before retrieving the sticker. Max score of 110 seconds if child waited all trials.
5. Completed Trial	Child received a score of 1 for each trial completed successfully and a score of 0 for each trial they ended early by retrieving the sticker before the assessor rang the bell. An average was calculated across the 5 trials.

Note. *Looking is independent of prompting/anticipatory behavior.

Table 3:

Descriptive Statistics

Variable	N	Mean	Std Dev	Min	Max
Average Prompts Total	60	3.75667	3.83845	0	14.6
Prompts Per Second	60	0.23269	0.22253	0	0.9359
Average Level Anticipation	60	1.38000	0.41774	0.20	2.2
Average Level Distraction	60	1.38667	1.08041	0	3.8
Total Delay	60	90.63333	26.49334	16.0	110.0
Completed Trial Average	60	0.77333	0.29566	0	1.0
Self Corrects Post-Switch	57	0.80702	1.05963	0	5.0
Errors Post-Switch	57	1.70175	2.40509	0	9.0
Internal State Word Sum	59	37.28814	7.05166	17.00	43.00

Table 4:

Correlations between Internal State Language and Inhibitory Control Tasks

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1. Average Prompts Total	--								
2. Prompts Per Second	0.839*	--							
3. Average Level Anticipation	0.114	-0.056	--						
4. Average Level Distraction	-0.541*	-0.717*	-0.221	--					
5. Total Delay	0.059	-0.397**	0.189	0.602*	--				
6. Completed Trial Average	-0.093	-0.508*	0.220	0.601*	0.910	--			
7. Self Corrects Post-Switch	0.078	0.040	0.173	-0.040	0.131	0.177	--		
8. Errors Post-Switch	-0.313	-0.144	-0.033	0.026	-0.284	-0.209	-0.289	--	
9. Internal State Word Sum	0.032	-0.003	0.062	0.211	0.186	0.180	0.260	-0.149	--

Note. $*p < .0001$, $**p < .001$

Figure Captions

Figure 1. General linear model revealed a strongly trending relationship between internal state word vocabularies and distraction group. Children with larger internal state word vocabularies tended to employ higher level distraction behaviors. Children in group 1 also exhibited the most variability in size of internal state word vocabularies.
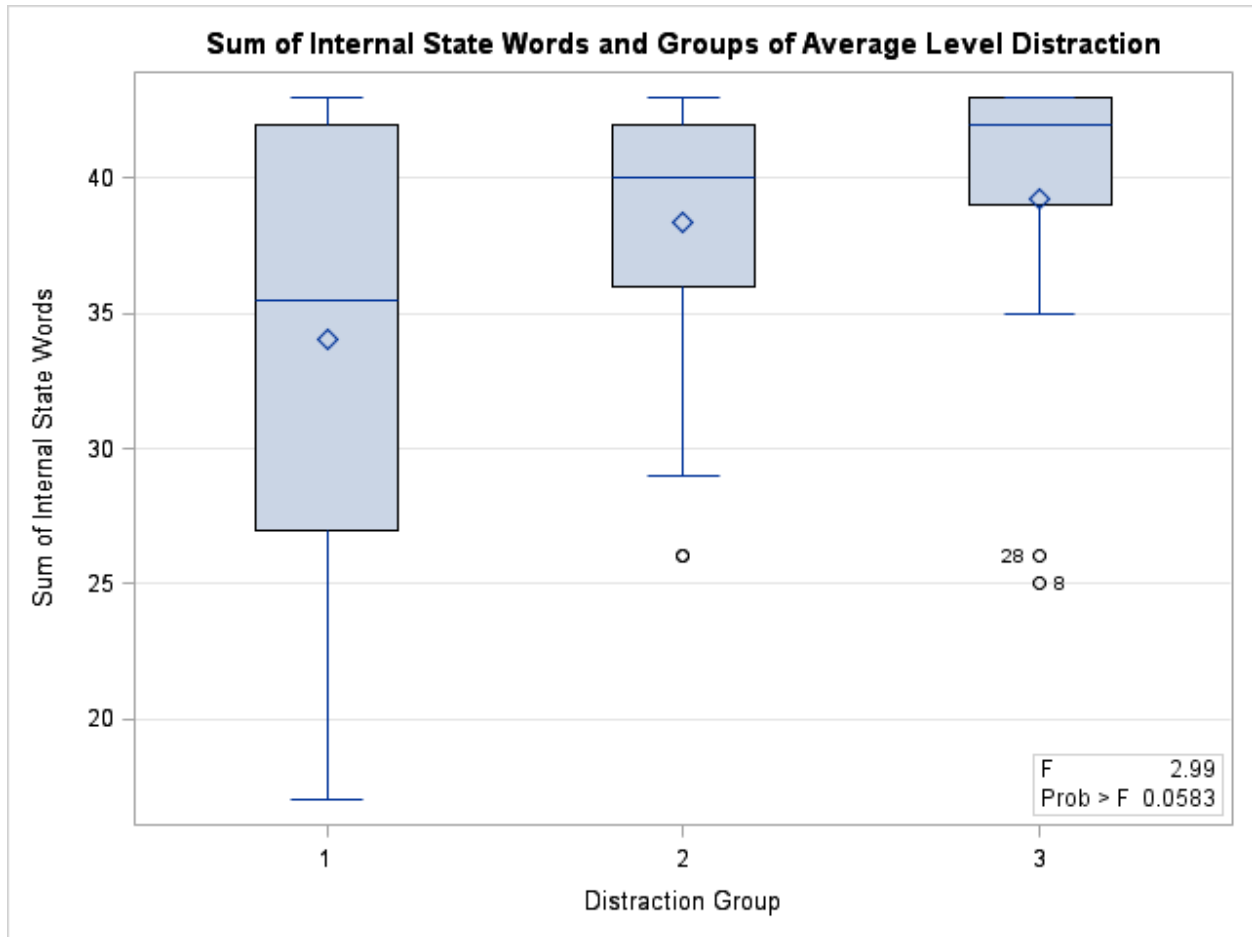*Note*. 1= Lowest average level distraction; 2= Middle average level distraction; 3= Highest average level distraction

Figure 2. A general linear model revealed a trending relationship between the number of self-corrects post-switch in the reverse categorization task and the size of internal state language vocabularies. Children with larger internal state language vocabularies tended to make more self-corrects post-switch than did those who made fewer self-corrects. Children with fewer self-correct behaviors also exhibited greater variability in the range of the size of their internal state word vocabularies.
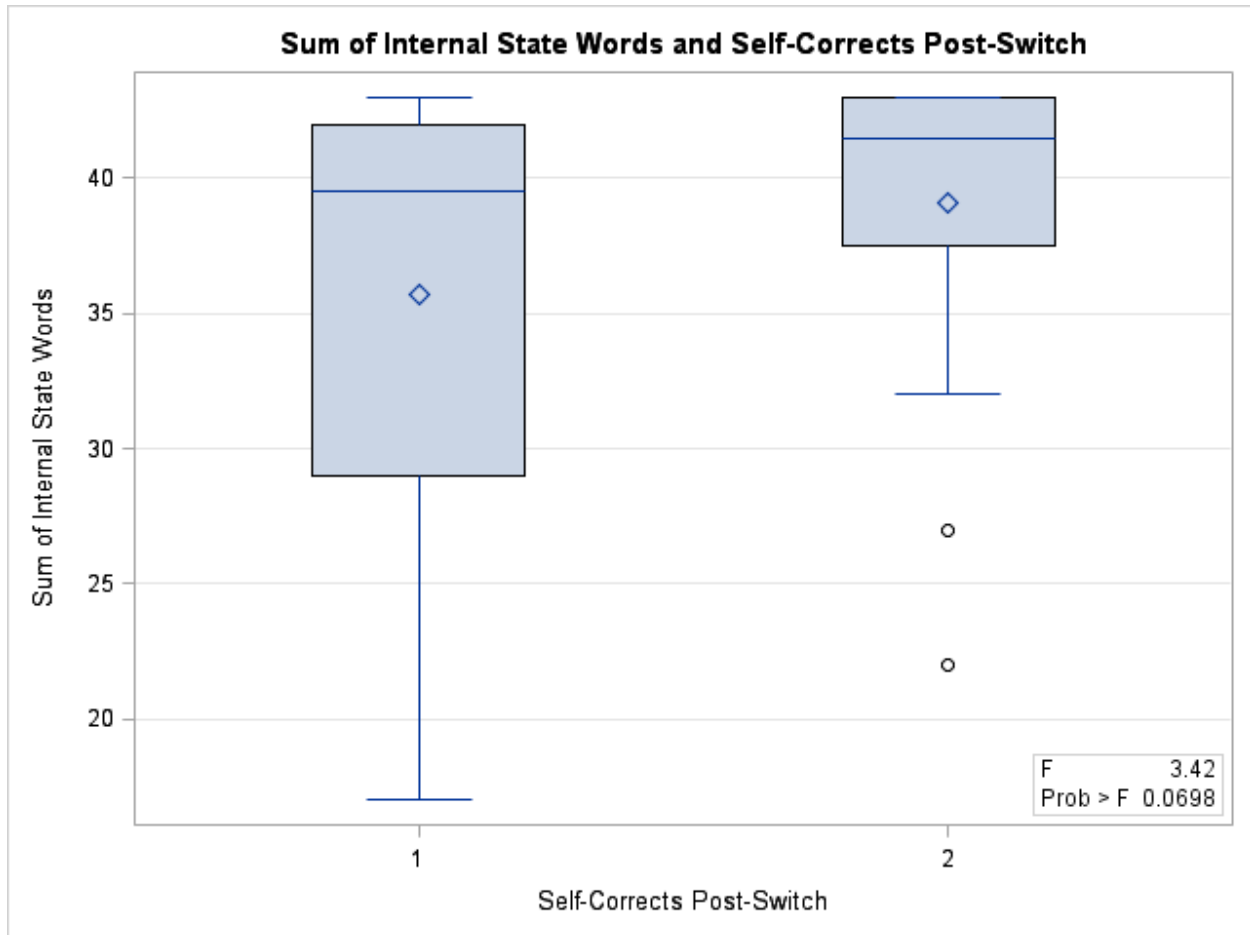*Note*. 1=Low numbers of self-corrects; 2=High numbers of self-corrects

Figure 3. A general linear model revealed a trending relationship between gender and the average level of distraction employed during the sticker task. Females tended to employ higher level distraction behaviors than did males.
Note. 1=Male; 2=Female

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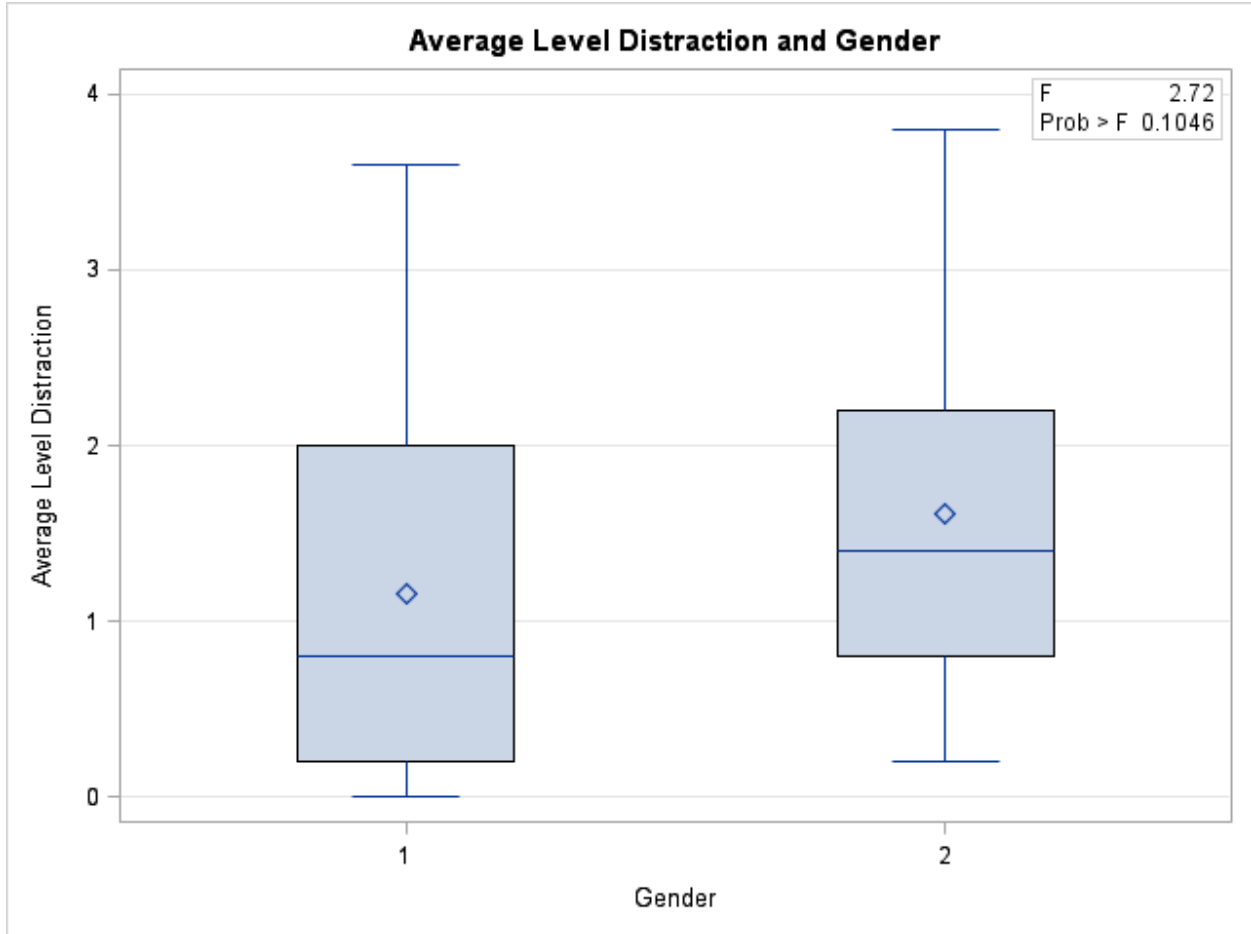*Note*. 1=Low numbers of self-corrects; 2=High numbers of self-corrects

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