



STAT Behavioral Domains as Predictors of ASD Severity and Cognitive Outcomes

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Abstract

The Screening Tool for Autism in Toddlers (STAT) has been established as a validated screener for ASD, but its utility as a measure of developmental abilities as not yet been assessed. The extent to which each of the four STAT domains relate to ASD symptom severity and cognitive ability has also not been determined. This study of 380 3-year-olds confirmed the measurement model of the STAT for the first time via confirmatory factor analysis and established that three of the four STAT domains significantly predict ASD severity, while some STAT domains also predict children's verbal and nonverbal cognitive ability. The STAT is a useful measure of children's general skills as they relate to two important outcomes in toddlerhood.

Background

- The Screening Tool for Autism in Toddlers (STAT) is a brief, interactive, validated screening assessment for autism comprised of 12 activity-based items that provide 4 behavioral domain scores—Imitation, Requesting, Directing Attention, and Play—as well as a total score indicating autism risk.
- The item-domain structure of the STAT is strongly grounded in theory but has never been validated via confirmatory factor analysis (CFA).
- The STAT domains represent discrete, developmentally appropriate social-cognitive skills, and each domain may differentially relate to both children's overall autism severity and cognitive ability when measured at 2-3 years.
- As a screener, the 4-domain STAT has been found to have high predictive validity with autism diagnosis in 2-3 year olds (Stone et al., 2008).
- However, it is not known how differentially predictive the STAT domains are of autism symptomatology and cognitive ability in a large sample of children recruited from the general population with elevated autism concern.

Research Aims

- To perform a CFA to confirm that items of the STAT theoretically proposed to form domains do indeed form the four STAT domains
- To perform a latent path model to assess how the STAT domains relate to ASD severity and cognitive ability.
 - Do all STAT domains relate to ASD severity?
 - Do STAT Requesting and Directing Attention domains relate to verbal cognitive ability?
 - Do STAT Play and Imitation domains relate to nonverbal cognitive ability?

Method

Sample

- Participants ($n=380$) were 24-39 months of age ($M=33$; $SD=4.14$) and recruited from eight sites funded as part of a National Children's Study formative research project.
- 79% of participants had prior autism concerns; 21% had concerns about developmental delay. 75% were male.

Procedure

- All participants received ASD diagnostic evaluations from a qualified clinician in the community or as part of the study.
- A different examiner administered the STAT and other measures to participants.

Variables of Interest

ASD severity: The calibrated severity score for each participants' ADOS administration was used as a continuous measure of ASD symptomatology.

Nonverbal and verbal cognitive ability: The Mullen Scales of Early Learning fine motor and visual reception subscales were averaged to create a nonverbal cognitive ability score. The Mullen's receptive and expressive language subscales were averaged to create a verbal cognitive ability score.

Domains from the Screening Tool for Autism in Toddlers and Young Children (STAT): The STAT has 12 interactive "items" in 4 domains (Figure 1):

- Imitation.** Action is demonstrated; does child imitate? Items: *Rattle. Roll car. Drum hands. Hop dog.*
- Requesting.** Communicative temptation; does child request? Items: *Bubbles. Food.*
- Directing Attention.** Communicative temptation; does child direct adult's attention to toy? Items: *Balloon. Puppet. Toys. Noisemaker.*
- Play.** Does child engage in back-and-forth or functional play? Items: *Turn-taking. Doll play.*



Figure 1: STAT domains (clockwise from top left): "drum hands" item from Imitation; "food" item from Requesting; "balloon" item from Directing Attention; "doll play" item from Play.

Analytic Plan

- All analyses were conducted using the lavaan analysis package in R.
- FIML was used across all analyses to account for missing data.

A **Confirmatory Factor Analysis** assessed how well the items comprising the 4 STAT domains—Play, Imitation, Requesting, and Directing Attention—mapped on to each domain.

A **Latent Path Model** assessed how participants' latent STAT domains related to ADOS severity score as well as verbal and nonverbal Mullen scores.

- State-of-the-art model-fitting procedures were employed for evaluation.
- Children's sex, maternal education, and race/ethnicity did not significantly predict STAT domains, ASD severity, or cognitive ability. They were therefore not included in final models.

Table 1: Sample Characteristics

Participant Race/Ethnicity	# (%)
White, Hispanic	69 (18)
White, Non-Hispanic	205 (54)
Black / African American	39 (10)
Asian	44 (12)
Other	23 (6)
Maternal Education	
<High School	14 (4)
High School Diploma	50 (13)
Some College	133 (35)
Bachelor's Degree	106 (28)
Masters or Above	76 (20)

Results

Confirmatory Factor Analysis: STAT Items Map onto STAT Behavioral Domains

- The theorized 4 latent factors for the Imitation, Requesting, Directing Attention, and Play STAT domains fit the data well (e.g., $X^2(48)=61.93$ [$p=.09$], $CFI=.987$; $RMSEA=.032$; $SRMR=.132$), supporting the item allocation into each STAT domain as originally designed.

Latent Path Model: STAT Domains Predict ASD Severity and Cognitive Ability

- The 4 resulting latent STAT domains were highly correlated. The final latent path model fit the data well (e.g., $X^2(78) = 99.04$ [$p=.05$], $CFI=.987$; $RMSEA=.027$; $SRMR=.035$).
- Three of the 4 latent STAT domain scores (Imitation, Requesting, and Directing Attention) were found to significantly predict ASD severity.
- STAT Play and Imitation domains were found to significantly predict nonverbal cognitive ability. The STAT Directing Attention domain was found to be the only significant predictor of verbal cognitive ability in the final, best-fitting model (Figure 2).
- Residual standardized variances for ASD severity, nonverbal, and verbal cognitive ability remained relatively high (ASD severity = 0.52; Nonverbal = 0.72; Verbal = 0.70)

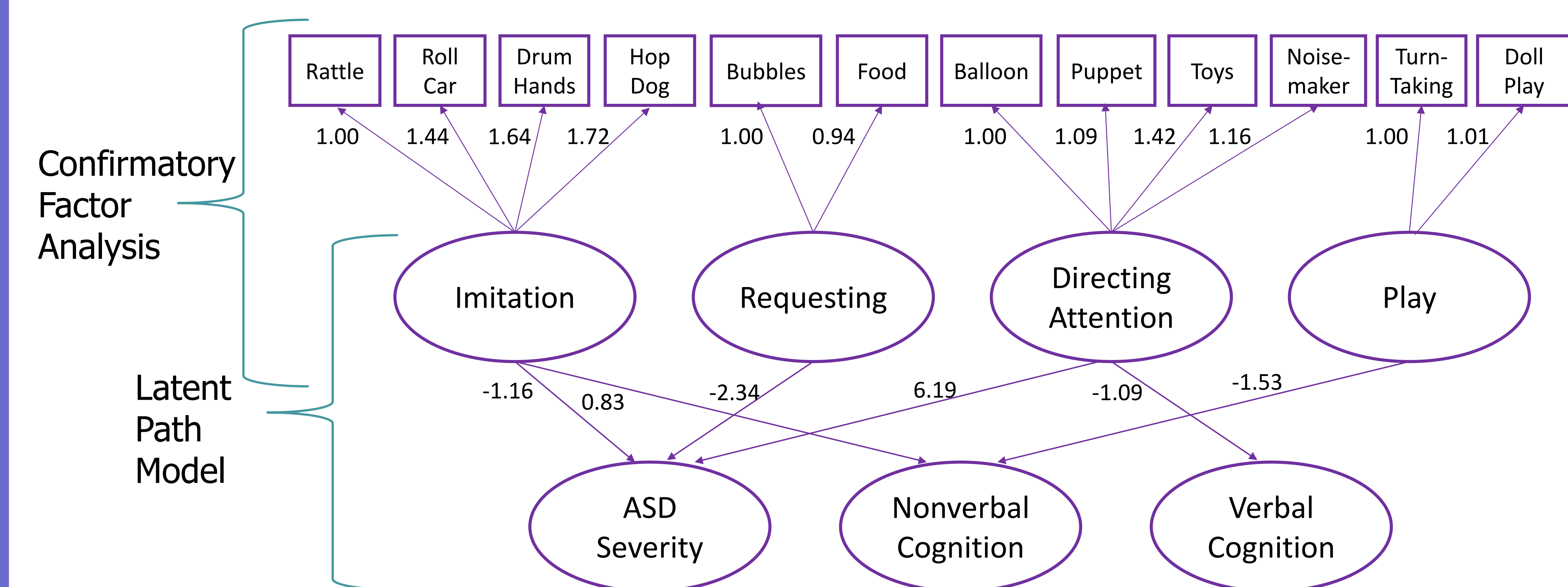


Figure 2: Full model: STAT domains (Play, Imitation, Requesting and Directing Attention) predict ASD severity and cognitive ability. Unstandardized estimates (betas) are presented to the left of their respective paths. All betas were significant at $p < .05$. Standard errors for all betas were reasonably sized. Covariances among the latent STAT domains and the outcomes are not shown for simplicity but all were significant at $p < .05$. Full model details are available on request.

Conclusions

- The STAT is both a theoretically and empirically coherent measure of four social-communicative behavioral domains. Three of these domains (Imitation, Requesting, and Directing Attention) could be sufficient to serve as a predictor of autism severity.
- The STAT domains are also useful individually; they are brief measures of developmental ability and can provide specific clinical information on social-cognitive challenges for young children.
- More play-based STAT domains (Imitation, Play) relate to nonverbal cognitive ability, while a more communication-based STAT domain (Direction Attention) relates to verbal cognitive ability.
- The STAT domains did not fully explain children's ASD severity and cognitive ability; other potential predictors include more direct measures of language ability.

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