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# Wrestling Proteus: Assessing the Varying Nature of Father Involvement Across Contexts

*This study investigated the common assumption that measures of father involvement are invariant across child age, gender, and reporter. Measurement invariance was tested with 320 families who were interviewed at child ages 10, 12, and 14. Criterion validity was also examined, using observational, survey, and physiologic measures with factor rotation type considered. It was found that invariance did not hold across gender for child report but did hold for mother and father reports. Differing factors were found across time and reporter. Child report and orthogonally rotated solutions demonstrated the greatest criterion validity. The findings suggest that typical father involvement assumptions may not hold and, when this is the case, involvement should be conceptualized in light of varying involvement domains. Implications for conceptualizing and analytically examining father involvement are considered.*

Research on how fathers influence their children's development has rapidly increased over the past three decades, with numerous linkages found between a father's involvement (FI) and the well-being of his child (Flouri, 2005; Lamb, 2000, 2010; Marsiglio, Amato, Day, & Lamb, 2000). Given the importance of FI, research has sought to understand factors that influence FI, including child age and gender (e.g., W. A. Collins & Russell, 1991; Larson, Richards, Moneta, Holmbeck, & Duckett, 1996; Paulson & Sputa, 1996; Sher-Censor, Parke, & Coltrane, 2011; Updegraff, Delgado, & Wheeler, 2009), and to understand how fathers, mothers, and children differentially report involvement (e.g., Gonzales, Cauce, & Mason, 1996; Mounts, 2007; Paulson & Sputa; Sher-Censor et al.).

Although previous research has uncovered much on how child age, gender, and reporter matter when understanding FI, as of yet the assumption of measurement invariance across these contexts has not been tested. That is, whereas previous research has focused on mean comparisons of FI across age, gender, and reporter, an issue that precedes this comparison is whether FI holds the same meaning across these (i.e., does FI have a protean nature?). Indeed, even though the same FI measure may be administered across contexts, the measure may not display the same properties and therefore be noncomparable. The rich literature on measurement invariance has emphasized this point well (e.g., Meredith, 1993; Widaman, Ferrer, & Conger, 2010; Widaman & Reise, 1997). As Vandenberg and Lance (2000) succinctly stated, "It makes no sense to conduct tests of

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group differences when the constructs that are being measured differ across groups'' (p. 37).

Assessing differences in FI measurement properties tests hypotheses of whether the nature (or perceived nature) of FI differs across contexts. It is important to note that these differences are in and of themselves a crucial phenomenon to study, perhaps more so than mean FI differences. Testing FI measurement invariance across contexts will provide more nuanced understanding and conceptualization of FI.

FI research often implicitly assumes invariant constructs across contexts. For example, the implicit assumption in a recent examination of whether the effect of FI differs by child gender was that FI has the same meaning and measurement structure across gender (Day & Padilla-Walker, 2009). Similarly, whereas Barber and colleagues (Barber, Stolz, Olsen, Collins, & Burchinal, 2005) examined the stability of the *effects* of parenting over time, they did not examine whether parenting's *measurement properties* also demonstrated such stability.

Age, gender, and reporter likewise have received little consideration in examinations of the multidimensionality of FI. For example, Schoppe-Sullivan, McBride, and Moon-Ho Ringo (2004) examined FI multidimensionality, but did not consider child age or gender. Not considering these factors may partially explain the mixed evidence regarding FI's dimensionality (see Pleck, 2010, for a discussion of mixed findings).

Measurement invariance has also often been overlooked in the creation of FI measures. For example, Hawkins and colleagues (2002) developed a 26-item FI scale (the Inventory of Father Involvement; IFI), with 723 fathers surveyed. Exploratory factor analysis (EFA) identified nine domains. Because all survey responses were included in the same EFA, invariance across child age, gender, and any other contextual variable was assumed. Also, because only fathers were sampled, whether their findings can be generalized to reports of other family members is unclear. Indeed, there may be domains of FI to which children and mothers are more attuned than fathers, and vice versa.

FI measurement differences also have substantial intervention implications. For instance, it may be that mother report of the father ''giving encouragement'' (an IFI item) is related to child well-being. Recommendations may then be made to increase father encouragement. Fathers, however, may interpret and enact ''encouragement'' differently from how mothers interpret it. Recommending that fathers give more encouragement may be ineffectual if the behaviors fathers associate with encouragement are not related to child well-being. Failing to account for the equivalency of mother and father reports introduces ambiguity in how to best tailor interventions. In this article, we outline how to examine these assumptions of measurement invariance and provide an empirical example. We systematically examined measurement invariance across child age, child gender, and mother, father, and child reports.

## Father Involvement Across Child Age

Measurement issues were addressed across the critical period from early to mid-adolescence. In 1997, Hosley and Montemayor noted that ''There has not been much longitudinal research exploring continuity and change in the father – child and father – adolescent relationship'' (p. 176). Lamb and Lewis (2010) reiterated this deficit, and Brown and Bakken (2011) noted of adolescent research that ''time itself represents another variable largely neglected by researchers; few attend to the specific features of the age group they study'' (p. 162).

Although some studies have investigated parent – child interactions across the adolescent period (e.g., Larson et al., 1996; Noack & Puschner, 1999; Paulson & Sputa, 1996), attention has focused on mean-level differences, with the implicit assumption that observable behaviors are equally indicative of the underlying factors across time (i.e., that the meaning of the observables does not change). Indeed, we found no study that examined the assumption of measurement invariance across time. It is highly likely, however, that the meanings of FI items evolve as the child ages. For example, one of the IFI items concerns ''taking care of the child.'' As the child matures this item likely takes on new meanings, because the behaviors associated with ''taking care'' change to meet the developmental needs of the child. Earlier in the child's life, ''taking care'' of him or her likely involves more instrumental caregiving activities, whereas later ''taking care'' may involve the father helping the child navigate the work and educational spheres the child begins to enter. Thus, the current study plays an important role in examining this assumption because we investigated whether latent FI measurement properties change as the child ages.

### Father Involvement and Child Gender

Some researchers have noted the uniqueness and similarities of various parent–adolescent dyads (i.e., father–son, father–daughter). For example, Hosley and Montemayor (1997) reviewed studies showing that child gender moderates the time fathers spend with their children, the degree of closeness felt between father and child, and how much the father knows about the child. In contrast, Russell and Saebel (1997) argued that differences between dyads were likely overstated (for a brief review of this literature, see Steinberg & Silk, 2002). Given these differences, there have been recent calls for further clarification (e.g., Brown & Bakken, 2011).

An integral part of this clarification is examining whether FI scales have the same measurement properties across gender. For example, the IFI contains an item about ''acting as a friend'' to the child. It may be that ''acting as a friend'' evokes gender-stereotypic ideas and thus holds different meanings across child gender. Respondents may therefore recall substantively different behaviors when considering a father being a friend to a male versus a female child.

Because gender similarities or differences may be moderated by the reporter, we examined measurement invariance across gender in the context of FI reporter. For example, father reports may have differing underlying structures of involvement for male versus female children, whereas mother reports may not. Given the lack of previous research, however, we made no specific hypotheses regarding which reporters may have more similar underlying structures across child gender.

### Reporter of Father Involvement

Although research has increasingly obtained perspectives from multiple family members, multiple perspectives of family dynamics in general and of the father's role in particular are lacking (Lamb & Lewis, 2010). Adolescents, fathers, and mothers may each view certain paternal behaviors as being more closely linked to each other (i.e., part of the same domain) and may reflect differing representations of the father. For example, Lamb and Lewis noted that ''maternal reports of high paternal involvement [could] reflect something else, like family harmony'' (p. 129). As adolescents, fathers, and mothers answer questions about the father, each may access conceptually different information, making for differing underlying constructs. We therefore examined whether the number of FI factors and their structures differ by reporter.

It is important to note that this investigation is distinct from an examination of who is a ''reliable'' FI reporter (e.g., Wical & Doherty, 2005). When discrepancies between reporters are found, questions regarding which reporter is ''most correct'' often arise, but discrepancies may be a function of differing underlying constructs rather than one reporter being more accurate than the other. In the FI literature, this possibility is rarely formally tested.

### Criterion Validity and Factor Overlap

This exploration of invariance across age, gender, and reporter necessitated at least two other measurement questions. The first concerns criterion validity. Although FI factors may differ significantly across reporter, they may be similar in their correlates and therefore display the same criterion validity. It may also be that distinct underlying structures are differentially related to correlates. We therefore examined how FI factors are associated with theoretically linked variables. Patterns of significant relationships across reporters will help identify how reporters may tap into varying aspects of FI. Coded observations of father–child interactions as well as reports of child well-being were used as correlates. Given previous research, we expected that greater FI would be associated with more positive father–child interactions and greater child well-being (Lamb & Lewis, 2010).

Other correlates include indices of the child's physiologic levels during and in response to interactions with the father. Vagal tone was used as an indicator of physiologic state, with high levels associated with a restful state with few, if any, perceived challenges (see Beauchaine, Gatzke-Kopp, & Mead, 2007; Porges, 2011). Fathers who engage in activities that build affection and trust may have children with higher levels of vagal tone during their interactions (i.e., children in a more restful state). Also important is the degree of vagal withdrawal in reaction to the fathers (indicating a change from higher to lower vagal tone). Fathers who engage in affection and trust building may also evoke less vagal withdrawal when the child is interacting with the father.

The second measurement question concerned the choice of whether to allow FI factors to correlate. Although researchers have delineated conceptually distinct FI domains (e.g., Hawkins et al., 2002; Palkovitz, 1997; see Pleck, 2010, for a discussion), when multiple factors are found the implications of allowing them to correlate have received little attention. In an exploratory fashion, we therefore examined factor structures and criterion validity of FI under two conditions: (a) FI factors are correlated and (b) FI factors are uncorrelated. In other words, we examined the conceptual, factor structure, and criterion validity implications of assuming independent or overlapping FI factors.

## The Current Study

Taken together, the current study addressed several FI measurement issues encountered in a wide variety of research; specifically, should researchers assume equivalency of FI measures across child age and gender, and mother, father, and child reports? How do reports of involvement differentially or similarly relate to important child and family variables? What are the implications of assuming overlapping (i.e., correlated) FI domains versus independent (i.e., uncorrelated) domains? It is important to note that this is only a single study, and a finding of invariance or noninvariance may not hold for alternate FI measures or across a differing age range. Nevertheless, this study provides the conceptual rationale, the methodological outline, and an empirical example for testing foundational measurement assumptions of FI research.

## Method

### *Sample*

Participants for this study were taken from Waves 1 through 5 of the Flourishing Families Study, an ongoing, longitudinal study of families with adolescents (see http://flourishingfamilies.byu.edu/). This is a community sample taken from a large urban center in the Northwest. Families were interviewed in their homes, with each interview consisting of a 1-hour video and a 90-minute self-administered questionnaire.

The sample consists of 500 families (147 single parent, 348 two parent) with a child between the ages of 10 and 14 ($M = 11$, $SD = 0.96$; 49.8% male) at Wave 1. For this study, we focused on two-parent households. Eighty-five percent of the two-parent families had a biological focal child. Seventy-six percent of mothers and 86% of fathers were European American, 13% of mothers and 6% of fathers were African American, 3% of mothers and 2% of fathers were Asian American, 2% of mothers and 1% of fathers were Hispanic, and 3% of mothers and fathers indicated that they were ‘‘mixed/biracial’’ or of another ethnicity. Fourteen percent of families reported an income less than $25,000 per year, 16% made between $25,000 and $50,000 a year, and 70% made more than $50,000 per year. Sixty percent of mothers and 70% of fathers had a bachelor’s degree or higher. The subsample used here consisted of 320 married or cohabiting heterosexual couples who did not separate during the time when the child was 10 to 14 (the time period used in this study).

### *Recruiting and Retention*

In 2007, families were recruited using the InfoUSA national database, which contained over 80 million households across the United States, with detailed information about each household. Families with a child between the ages of 10 and 14 were first identified from targeted census tracts that mirrored the socioeconomic and racial stratification of reports of local target school districts within the target community. Of the 744 eligible families contacted, 500 agreed to participate (67% response rate). The most frequent reasons families cited for not participating in the study were lack of time and concerns about privacy. The retention rate from Waves 1 to 5 was 93%.

### *Sequential Cohort*

To reduce the heterogeneity of ages within waves of data (originally, a 5-year time span within waves), data were reconfigured into a cohort sequential design by age of the child. We isolated three ages for this study: 10 ($n = 222$, $M = 10.62$, $SD = 0.50$), 12 ($n = 320$, $M = 12.65$, $SD = 0.60$), and 14 ($n = 320$, $M = 14.54$, $SD = 0.61$). There are approximately 100 fewer cases at age 10 because only Wave 1 was used to create this cohort, whereas multiple waves were used to create the Age 12 and Age 14 cohorts.

Table 1. *Father Involvement Items*

| Item No. | Item Text | Domain From Exploratory Factor Analysis in Hawkins et al. (2002) |
|---|---|---|
| 1 | Attend your child's activities (like a soccer game or something he/she is doing at school)? | Attentiveness |
| 2 | Read books or magazines with your child? | Reading and Homework Support |
| 3 | Give encouragement to your child? | Praise and Affection |
| 4 | Take care of your child (like fix him/her food or pick him/her up from school)? | Attentiveness |
| 5 | Act as a friend to your child? | Time and Talking Together |
| 6 | Work hard to pay for things your child needs? | Providing |
| 7 | Help your child with homework? | Reading and Homework Support |
| 8 | Make it easy for your child to talk to you? | Time and Talking Together |

### *Measures*

*Father involvement.* Father involvement was measured using a reduced version of Hawkins et al.'s (2002) IFI that included eight items. Responses regarding the frequency of activities related to the child's life were made on a 5-point Likert scale, ranging from 1 (*never*) to 5 (*always*). Items included giving encouragement, reading books, attending activities, taking care of the child, acting as a friend, helping with homework, making it easy for the child to talk to the father, and working hard to pay for the child's needs (see Table 1). Adolescents and mothers responded to these items regarding the father, and fathers responded about themselves.

The eight items were selected from the original 26 on the basis of their applicability to the early adolescent period and because they represented several FI domains as identified by Hawkins et al. (2002; see Table 1 for Hawkins et al.'s domains of items). It is important to note that Hawkins et al.'s domains were derived via EFA without consideration of child characteristics or other contexts. The current examination is therefore important in that it provides evidence of whether these domains remain invariant. Given the reduced number of items, we did not fully replicate Hawkins et al.'s analysis; however, it was highly instructive to examine whether items loaded similarly. Because it is not unusual for large-scale surveys to use reduced-size scales (in particular for applicability to age or other characteristics), the current study measurement invariance tests are highly relevant. Descriptive statistics of FI measures are in the Appendix.

*Observational data.* An interaction between the father and adolescent was videotaped and coded by trained observers using the Iowa Family Interaction Rating Scales (Melby et al., 1998). For the current study, we used observed father and child prosocial and antisocial behaviors. *Prosocial behaviors* are demonstrations of helpfulness, sensitivity toward others, cooperation, sympathy, and respectfulness toward others in an age-appropriate manner. This also reflects a level of maturity appropriate to one's age. *Antisocial behaviors* demonstrate self-centeredness; egocentricity; acting out; and out-of-control behaviors that show defiance, active resistance, insensitivity toward others, or a lack of restraint. They also reflect immaturity and age-inappropriate behaviors.

*Participant report.*

Child school engagement. The child's level of behavioral functioning at school, including his or her ability to get homework done and behave appropriately, was measured with a self-report nine-item modified version of a school engagement scale (Fredricks, Blumenfeld, & Paris, 2004). Respondents were asked the degree to which they agreed or disagreed with items such as "I pay attention in class" and "I am interested in the work at school." Responses ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). Higher scores reflect a greater ability to focus and engage in prosocial behavior and get homework done. Alphas across the years ranged from .79 to .85.

Child internalizing and externalizing behaviors. Internalizing and externalizing behavior problems were measured using the delinquency and depression/anxiety-related items from Barber et al. (2005). These questions were originally adapted from the Child Behavior Checklist Youth Self-Report (Achenbach, 1991). We used child reports of internalizing behaviors. Items included ''I am unhappy, sad or depressed'' and ''I feel worthless or inferior.'' For externalizing behaviors, we used mother reports. Externalizing items included ''My child lies or cheats'' and ''My child steals things from places other than home.'' Responses ranged from 0 (*not true*) to 2 (*very true or often true*), with higher scores representing higher levels of depression/anxiety symptoms. There is extensive evidence of both reliability and validity of these measures, and there is evidence that this scale has cross-ethnic equivalence (Krishnakumar, Buehler, & Barber, 2003). Cronbach's alphas for internalizing behaviors ranged from .84 to .86, and those for externalizing behaviors ranged from .68 to .79.

*Vagal tone.* Vagal tone was captured at Wave 5 (when adolescents were 14 years old). Following standard guidelines (Berntson, Cacioppo, & Quigley, 1991), vagal tone was indexed by respiratory sinus arrhythmia (RSA) using ECG electrodes. Given space constraints, details of RSA measurement equipment and settings are available on request. RSA data were collected under a variety of conditions. For the purposes of this study, we used RSA levels and reactivity during a 3-minute father–child task. During this task, the father and child were asked to list activities they usually do together and talk about what they especially enjoy about each activity as well as things they would like to improve. We used the average level of RSA during the activity (labeled simply *RSA*) as well as the reactivity of the RSA (labeled *RSA-R*) to the 3-minute baseline established just prior to the task. During the 3-minute baseline the child was instructed to remain still and not speak.

### *Controls*

In the partial correlations we controlled for family monthly income (the natural log), child gender (1 = *male*, 0 = *female*), and race (1 = *Black/African American*, 0 = *White/Caucasian*) because they may confound the relationship between FI and the correlates.

### *Analysis Plan*

Analyses proceeded in several steps. In the first step, the number of FI factors was determined for mother, father, and child reporter at each time point. For each reporter we then examined whether factorial invariance held across child ages. Following this, we determined whether, at each child age, factorial invariance held across reporters. Next we examined, by child age and reporter, whether factorial invariance held across child gender. Finally, we observed the relationship of FI factors across child age and reporter with the hypothesized correlates. When examining factor loadings and extracting factors for testing criterion validity, we report both the orthogonal and oblique rotations.

### *Determining the Number of Factors*

We conducted an initial EFA to determine the number of factors across reporter (adolescent, father, mother) and across ages 10, 12, and 14. This led to a series of nine EFAs (three reporters × three time periods). We used the robust maximum likelihood estimator because it is robust to data nonnormality (see Muthén & Muthén, 2010, for additional details). Chi-square difference tests were conducted with the appropriate maximum likelihood estimator scaling correction factor (Satorra, 2000). We used the Mplus default of oblique Geomin (OB) rotation (correlated factors) because it was developed to allow for complex factors and provide an interpretable pattern matrix (Yates, 1987) and because it has been recommended when cross-loadings are likely (Browne, 2001). We then used an orthogonal Geomin (OR) rotation (uncorrelated factors).

We used the standard 1.0 eigenvalue (EV) cutoff to determine the number of factors. There were, however, some instances in which factor EVs approached 1.0 (>0.95). To determine whether these factors should be retained, we used the chi-square difference test to examine whether the addition of that factor substantially improved model fit; that is, we fit one EFA model specifying the number of factors with EVs >1.0 and another model that adds the factor with an eigenvalue > .95 and compared model fit. We also report the differences in the relative fit indices comparative fit index (CFI) and root-mean-square error of approximation (RMSEA). Among the many relative fit indices we chose these two because they varyingly emphasize aspects of model fit. The generally accepted cutoff for a good model fit is a CFI of .95 or higher and an RMSEA of .06 or lower (see Hu & Bentler, 1999).

### *Testing Factorial Invariance*

To test whether latent factors are equivalent across age, gender, and reporter, we followed Meredith's (1993) outline of testing factorial invariance, which includes examining four types of invariance: (a) configural, (b) weak, (c) strong, and (d) strict (see also Widaman & Reise, 1997). These comprise a taxonomy of models with increasing measurement constraints. Configural invariance, in which the same pattern of fixed and free factor loadings are specified, is the least restrictive. Weak invariance imposes constraints on factor loadings; strong invariance imposes constraints on loadings and intercepts; and, finally, strict invariance imposes constraints on loadings, intercepts, and residual variances. Each model is compared to the proceeding model (i.e., weak compared to configural, strong compared to weak, and strict compared to strong). In all models we correlated errors across reporters on parallel items to account for systematic item-based error.

Substantively, when loadings are equal over time or across groups, items have the same validity, indicating that the items capture the underlying construct equally well. Testing invariance of the intercept has been considered a test for systematic response bias. By testing equality of residual variances, one can examine whether the reliability of the items is the same over time (see Bollen, 1989; Raines-Eudy, 2000; and Vandenberg & Lance, 2000, for additonal discussion of substantive meanings). In order for it to be said that latent variables measure the same underlying construct, at least strong invariance must hold. As Widaman and Reise (1997) summarized, ''Thus, for most substantive research questions, constraints on the [loadings and intercepts]—embodying strong factorial invariance—would usually be considered crucial'' (p. 296).

We used chi-square difference tests to determine whether imposing constraints decreased model fit. Decreases in fit are evidence that factors are not invariant at that level. Although the chi-square test is essential in examining invariance, because of its sensitivity to sample size it has been suggested that practical fit indices also be examined (Widaman et al., 2010; Widaman & Reise, 1997). We therefore also report the CFI and RMSEA.

After identifying the number of factors across time and reporter, we investigated whether factor structures were invariant across time for each reporter. Because there may be a differing number of factors at each time point, we used the number of factors at age 10 as a baseline. Although the number of factors may differ, it may still be that imposing the 10-year number of factors and testing invariance does not significantly decrease model fit.

We then examined measurement invariance for boys and girls by fitting multiple-group models (Asparouhov & Muthén, 2009) and testing weak, strong, and strict invariance. After this, we examined invariance across reporter by comparing each reporter against the other two reporters who have the same number of factors within time. Given that there is no clear baseline number of factors for reporters (i.e., there is no clear progression as there is for child age), we did not compare reporters with differing numbers of factors.

Using Mplus 6.12 (Muthén & Muthén, 2010), we employed the relatively recent method of exploratory structural equation modeling (ESEM) to test factorial invariance (Asparouhov & Muthén, 2009). In essence, this method differs from the more common confirmatory factor analysis (CFA) in that it has the flexibility of EFA (including rotated solutions) along with the ability to impose model constraints to test hypotheses regarding factorial invariance. In contrast to CFA, each item is allowed to load on each factor, providing substantial flexibility. This is particularly important in the current analyses because items likely are indicators of more than a single factor. Because the purpose of this investigation was to identify how factor structures may vary by time, reporter, and gender, imposing zero loadings may result in statistically significant factorial differences that may not be significant if zero loadings were not imposed.

For example, in typical CFA some loadings for FI would be constrained to zero for one factor while allowed to be estimated in the other factor (i.e., no cross-loading). Whether the loading is constrained to zero often depends on whether it is greater than a particular threshold value (e.g., .30 or .40). It may be, for example, that the father report does not meet this threshold but the child report does. If the father report factor is constrained to zero and the child report is free to vary, comparisons of child and father loadings are much more likely to reject the null hypothesis of invariant loadings.

Constraining loadings to zero has other implications. Asparouhov and Muthén (2009) note that ''misspecification of zero loadings usually leads to distorted factors with over-estimated factor correlations and subsequent distorted structural relations'' (p. 397). Allowing for nonzero loadings also may allow for better identification of substantively different and less correlated factors (Marsh et al., 2010; see also Marsh et al., 2009). Although restricting items to load on a single factor may simplify factors, Sass and Schmitt (2010) pointed out that ''allowing for solutions that are more complex provides a more realistic depiction of the domains of interest'' (p. 76).

### *Hypothesized Correlates*

We used a two-step approach to determine how FI factors covary with hypothesized correlates. In the first step, we examined partial correlations between each factor of FI and hypothesized correlates within each time period, controlling for family income, race, and child gender.

In the second step, we investigated whether significant correlations between factors and hypothesized correlates could be explained by the other factor(s) within reporter. We therefore added the other factor(s) within reporter to the partial correlation as a control. For example, in Step 1 it may be found that two FI factors of child report significantly covary with a child's externalizing behaviors. The second step then includes both factors in the partial correlation to control for each other. If both factors remain significantly correlated with externalizing behaviors, then each factor explains unique variance in externalizing behaviors; however, if one is no longer significant, it can be concluded that one of the factors is correlated with externalizing behaviors because of its covariance with the other factor.

### *Missing Data*

We handled missing data using full information maximum likelihood although, as mentioned earlier, nonresponse missing data were minimal. When comparing 10-year FI to 12 and 14-year FI, the smaller 10-year cohort was missing data for approximately 100 cases. Given the cohort sequential design, these data are missing completely at random because older adolescents were no more likely to be in the sample than younger adolescents.

## Results

### *Number of Factors*

For all three reporters at 10 years, two factors had EVs above 1.00. The EV for a third factor of adolescent report approached 1.00 (0.96), although no items significantly loaded on the additional factor and we found a nonsignificant improvement in model fit from the two-factor solution to the three-factor solution, favoring the simpler two-factor model.

For adolescent report at age 12, only one factor had an EV above 1.00 (EV = 3.62), with none approaching 1.00 (the next closest was .85). Thus, the one-factor solution was selected. Mother report had one factor with an EV above 1 and a second with an EV of 0.98. We examined the model fit and found substantial improvement from one to two factors, $\Delta\chi^2(7) = 48.55, p < .001$ (CFI of .90 vs. .97 and RMSEA of .10 vs. .06). We therefore chose the two-factor solution. For father report, two factors had EVs above 1 (Factor 1 EV = 2.87, Factor 2 EV = 1.11), with none close to 1.00.

At age 14, two factors of adolescent report had EVs above 1 (Factor 1 EV = 3.27, Factor 2 EV = 1.05), as did mother report (Factor 1 EV = 3.27, Factor 2 EV = 1.01). Father report had two factors above 1.00 (Factor 1 EV = 2.72, Factor 2 EV = 1.15), with the third factor having an EV of exactly 1.00. The three-factor solution fit substantially better than the two-factor model, $\Delta\chi^2(6) = 33.58$, $p < .001$ (CFI of .89 vs. .99 and RMSEA of .10 vs. .06), and three factors were retained.

Table 2 contains OB factor loadings, and Table 3 provides OR loadings. Although there were loadings for each of the eight items on all factors (as per ESEM), for ease of visualization we omitted those less than .30. On the basis of subsequent analyses (see below), loadings for mother and father reported in Table 2 were constrained at ages 10 and 12, as were loadings for mother and adolescent report at age 14. It is important to note that, despite the unstandardized loadings being constrained, standardized loadings may differ to some degree.

### *Invariance Across Time*

Table 4 contains details on invariance tests across time for each reporter. To examine invariance across time, we took the 10-year number of factors as a baseline for comparisons

Table 2. *Standardized Factor Loadings Greater Than .30, Geomin Oblique Rotation*

| | Child | | Mother | | Father | | |
|---|---|---|---|---|---|---|---|
| Reporter | 1 | 2 | 1 | 2 | 1 | 2 | 3 |
| Age 10 | | | | | | | |
| 1. Attend activities | 0.67 | | | | 0.30 | | |
| 2. Read books | 0.48 | | | | | | |
| 3. Encouragement | 0.48 | 0.32 | | 0.55 | | 0.53 | |
| 4. Take care of | | 0.36 | 0.71 | | 0.77 | | |
| 5. Act as a friend | | 0.92 | | 0.55 | | 0.60 | |
| 6. Work hard | | 0.31 | | 0.44 | | 0.43 | |
| 7. Homework | | | 0.44 | | 0.43 | | |
| 8. Make it easy for child to talk to you | | 0.51 | | 0.78 | | 0.82 | |
| Age 12 | | | | | | | |
| 1. Attend activities | 0.49 | | 0.47 | | 0.40 | | |
| 2. Read books | 0.49 | | 0.48 | | 0.40 | | |
| 3. Encouragement | 0.74 | | | 0.76 | | 0.70 | |
| 4. Take care of | 0.53 | | 0.48 | | 0.38 | | |
| 5. Act as a friend | 0.75 | | | 0.65 | | 0.66 | |
| 6. Work hard | 0.48 | | | | | | |
| 7. Homework | 0.57 | | 0.75 | | 0.68 | | |
| 8. Make it easy for child to talk to you | 0.78 | | | 0.81 | | 0.83 | |
| Age 14 | | | | | | | |
| 1. Attend activities | 0.62 | | 0.61 | | 0.69 | | |
| 2. Read books | | .37 | | | | 0.63 | |
| 3. Encouragement | 0.61 | | 0.58 | | | | 0.62 |
| 4. Take care of | 0.69 | | 0.60 | | 0.33 | | 0.32 |
| 5. Act as a friend | | .66 | | 0.61 | | | 0.60 |
| 6. Work hard | 0.45 | | 0.37 | | | | 0.33 |
| 7. Homework | | .30 | | | | 0.46 | |
| 8. Make it easy for child to talk to you | | .87 | | 0.78 | | | 0.66 |

*Note*: Loadings for mother and father reports were constrained at ages 10 and 12, as were loadings for mother and child reports at age 14. No other constraints were added.

(i.e., two factors across adolescent, mother, and father report). Even though father report of involvement at 14 years had three factors and adolescent report at 12 years had only one factor, we imposed a two-factor solution for comparisons.

In each comparison of father report weak invariance held, although strong invariance did not hold at any point.

For adolescent report, there were serious estimation errors when we attempted to fit a two-factor model at 12 years to make comparisons with the 10- or 14-year factors. This is likely due to attempting to extract too many factors at age 12 (again, EFA indicated that a single factor was optimal). We were therefore unable to examine invariance across time for adolescent report at age 12. In the 10-to-14 comparison there was a minor decrement to model fit from configural to weak invariance, $\Delta\chi^2(10) = 25.62, p < .05$ (CFI of .94 vs. .92 and RMSEA of .05 vs. .05); however, there were substantial decreases in model fit from weak to strong invariance, $\Delta\chi^2(8) = 160.97, p < .001$ (CFI of .92 vs. .67 and RMSEA of .05 vs. .09).

In sum, there was no indication that FI domains were invariant across time for any reporter. This indicates that examining mean growth in FI would not be justified.

Table 3. *Standardized Factor Loadings Greater Than .30, Geomin Orthogonal Rotation*

| | Child | | Mother | | Father | | |
|---|---|---|---|---|---|---|---|
| Reporter | 1 | 2 | 1 | 2 | 1 | 2 | 3 |
| Age 10 | | | | | | | |
| 1. Attend activities | 0.61 | | | 0.41 | | 0.45 | |
| 2. Read books | 0.44 | 0.34 | | 0.42 | | 0.47 | |
| 3. Encouragement | 0.45 | 0.51 | | 0.61 | | 0.62 | |
| 4. Take care of | | 0.48 | −0.33 | 0.62 | | 0.71 | |
| 5. Act as a friend | | 0.92 | | 0.52 | | 0.61 | |
| 6. Work hard | | 0.30 | 0.36 | | | | |
| 7. Homework | | | | 0.58 | | 0.60 | |
| 8. Make it easy for child to talk to you | | 0.61 | 0.49 | 0.62 | 0.40 | 0.70 | |
| Age 12 | | | | | | | |
| 1. Attend activities | 0.49 | | 0.35 | 0.35 | 0.33 | 0.35 | |
| 2. Read books | 0.50 | | 0.36 | 0.34 | 0.33 | 0.34 | |
| 3. Encouragement | 0.74 | | | 0.77 | | 0.71 | |
| 4. Take care of | 0.53 | | 0.36 | 0.40 | 0.32 | 0.38 | |
| 5. Act as a friend | 0.75 | | | 0.65 | | 0.65 | |
| 6. Work hard | 0.48 | | | 0.31 | | | |
| 7. Homework | 0.57 | | 0.56 | 0.35 | 0.56 | 0.37 | |
| 8. Make it easy for child to talk to you | 0.78 | | | 0.81 | | 0.83 | |
| Age 14 | | | | | | | |
| 1. Attend activities | 0.47 | 0.41 | 0.36 | 0.37 | 0.72 | | 0.30 |
| 2. Read books | | 0.43 | | 0.32 | 0.31 | 0.55 | |
| 3. Encouragement | 0.46 | 0.54 | 0.34 | 0.47 | | | 0.70 |
| 4. Take care of | 0.52 | 0.46 | 0.35 | 0.36 | | | 0.42 |
| 5. Act as a friend | | 0.68 | | 0.62 | | 0.43 | 0.53 |
| 6. Work hard | | | | | | | 0.35 |
| 7. Homework | | 0.46 | | 0.40 | | 0.46 | |
| 8. Make it easy for child to talk to you | | 0.87 | | 0.78 | | 0.35 | 0.63 |

*Note*: Loadings for mother and father reports were constrained at ages 10 and 12, as were loadings for mother and child reports at age 14. No other constraints were added.

### *Invariance by Reporter*

We next examined invariance across reporter. At age 10, two factors were identified for each reporter. We first compared mother and adolescent reports, finding that weak invariance did not hold, $\Delta\chi^2(12) = 23.87$, $p < .05$ (configural CFI = .95, RMSEA = .04; weak invariance CFI = .92, RMSEA = .05); neither did weak invariance hold for father and adolescent reports, $\Delta\chi^2(12) = 24.38$, $p < .05$ (configural CFI = .96, RMSEA = .04; weak invariance CFI = .94, RMSEA = .04). Weak invariance held for mother and father reports, $\Delta\chi^2(12) = 14.02$, $p > .05$ (configural CFI = .98, RMSEA = .03; weak invariance CFI = .98, RMSEA = .03), but not at strong invariance (i.e., intercepts constrained), $\Delta\chi^2(8) = 24.00$, $p < .01$ (weak CFI = .98, RMSEA = .03; strong CFI = .96, RMSEA = .04).

At 12 years, both mother and father reports had two factors and could therefore be compared. With only one factor, adolescent report was not compared to mother or father report. Although there was a significant decrease in the chi-square from configural to weak invariance, $\Delta\chi^2(12) = 26.42$, $p < .01$, there was only a .01-point change in the CFI and no change in the RMSEA (configural CFI = .95, RMSEA = .05;

Table 4. *Comparing Factor Structures Across Time With the 10 Year Number of Factors as Baseline*

| | Father Involvement | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Father Report | | | | Child Report[a] | | | |
| | Config. | Weak ($\Delta df = 12$) | Strong ($\Delta df = 8$) | Strict ($\Delta df = 8$) | Config. | Weak ($\Delta df = 12$) | Strong ($\Delta df = 8$) | Strict ($\Delta df = 8$) |
| Age | | | | | | | | |
| 10 vs. 12 | | | | | | | | |
| $\Delta\chi^2$ | | 13.331 | 68.82*** | 5.52 | | | | |
| CFI | .993 | .991 | .926 | .931 | | | | |
| RMSEA | .017 | .017 | .047 | .044 | | | | |
| 10 vs. 14 | | | | | | | | |
| $\Delta\chi^2$ | | 14.97 | 94.91*** | 14.21 | | 25.62* | 160.97*** | 10.66 |
| CFI | .955 | .953 | .811 | .804 | .938 | .922 | .689 | .706 |
| RMSEA | .04 | .038 | .074 | .072 | .046 | .048 | .091 | .085 |
| 12 vs. 14 | | | | | | | | |
| $\Delta\chi^2$ | | 14.53 | 48.35*** | | | | | |
| CFI | .961 | .958 | .876 | | | | | |
| RMSEA | .044 | .043 | .07 | | | | | |
| Mother report | | | | | | | | |
| 10 vs. 12 | | | | | | | | |
| $\Delta\chi^2$ | | 33.79** | 29.52*** | 3.45 | | | | |
| CFI | .923 | .908 | .873 | .881 | | | | |
| RMSEA | .058 | .059 | .066 | .062 | | | | |
| 10 vs. 14 | | | | | | | | |
| $\Delta\chi^2$ | | 12.26 | 107.34*** | 15.99* | | | | |
| CFI | .966 | .966 | .798 | .789 | | | | |
| RMSEA | .034 | .031 | .073 | .072 | | | | |
| 12 vs. 14 | | | | | | | | |
| $\Delta\chi^2$ | | 29.68** | 96.60*** | 12.20 | | | | |
| CFI | .991 | .981 | .926 | .923 | | | | |
| RMSEA | .024 | .032 | .061 | .059 | | | | |

*Note*: Each model is compared to the proceeding model (i.e., weak is compared to configural, strong is compared to weak, and strict is compared to strong). Config. = configuration; CFI = comparative fit index; RMSEA = root-mean-square error of approximation.

[a]There were serious estimation errors when attempting to fit a two-factor model at 12 years along with the 10- or 14-year data. This is likely due to attempting to extract too many factors at age 12 (the model fit indicated one factor was optimal). We were therefore unable to examine invariance across time for child report with 12-year reports.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

weak invariance CFI = .94, RMSEA = .05). That is, unlike previous analyses, a substantial drop in relative fit did not accompany the drop in absolute fit. From this we concluded that weak invariance holds. Strong invariance, however, did not hold, $\Delta\chi^2(8) = 45.69$, $p < .001$ (weak CFI = .94, RMSEA = .05; strong CFI = .91, RMSEA = .06).

At 14 years, mother and adolescent reports both had two factors, whereas father report had three. Imposing weak invariance for mother and adolescent reports had a nonsignificant change in chi-square and an improved relative model fit, $\Delta\chi^2(12) = 6.185, p > .05$ (configural CFI = .96, RMSEA = .04; weak invariance CFI = .98, RMSEA = .03). Strong constraints significantly decreased model fit, however: $\Delta\chi^2(8) = 45.95$, $p < .001$ (weak CFI = .98, RMSEA = .03; strong CFI = .95, RMSEA = .04).

In sum, weak invariance held for mother and father reports at 10 and 12 years as well as for adolescent and mother reports at 14 years. In none of the comparisons did strong invariance hold, indicating that at no time point are factor means comparable across reporters.

### Invariance by Gender

Relative model fit for mother report of FI increased as constraints were added, giving no indication that factor structures vary by gender. This was also the case for father report, except when strict invariance was imposed at age 14, $\Delta\chi^2(8) = 23.75$, $p < .01$ (strong CFI = .97, RMSEA = .05; strict CFI = .91, RMSEA = .07).

For adolescent reports at 10 years there was some indication of variant factor structures with a decrease in relative fit from configural to weak, despite the nonsignificant chi-square difference (configural CFI = .98, RMSEA = .05; weak CFI = .95, RMSEA = .06), although there was a significant chi-square decrease and from weak to strong accompanied by decreases in relative fit, $\Delta\chi^2(8) = 17.88$, $p < .05$ (strong CFI = .92, RMSEA = .07). We therefore concluded that strong invariance does not hold at age 10 across gender. Little evidence of variance at age 12 was found, though at age 14 model fit was substantially worse from weak to strong invariance, $\Delta\chi^2(8) = 20.26$, $p < .01$ (weak CFI = .98, RMSEA = .04; strong CFI = .95, RMSEA = .06). Thus, for parent reports, FI factor means are likely comparable across gender, whereas child reports are likely not.

### Hypothesized Correlates

Factor scores for adolescent, father, and mother report of FI were saved using the Mplus SAVEDATA command and exported to Stata 12 to conduct partial correlations. Partial correlations (controlling for race/ethnicity, income, and adolescent gender) were conducted for OB and OR versions of each factor of Tables 2 and 3 and each of the predicted correlates. Two sets of partial correlation analyses were conducted, the first not controlling for the other factor(s) within reporter and the other controlling for them. The results of the second analysis are displayed in Table 5. Partial correlations significant at $p < .05$ are displayed. Consistency across reporters and time are particularly important to observe.

In the first analysis (not controlling for the other factor[s]), there were 58 significant correlations for the OB rotation and 47 significant for the OR. When controlling for the other factor, however, there were 33 significant correlations for OB factors and 43 significant OR factors. This includes several correlations that became significant when controlling for the other factor that were not significant when not controlling for it (this primarily occurred in physiologic correlations). For example, the OR Factor 1 was not significantly related to RSA-R for adolescent or mother report; however, when the other factor was controlled for these became significant. Furthermore, for OB factors there was no significant relationship between RSA and adolescent report factors, but when controlling for each other, both factors were significant. As hypothesized, greater involvement was related to more positive and less negative father – adolescent interactions and greater adolescent well-being. Although not always in the hypothesized direction (as we discuss below), the direction of the relationship between physiologic measures and FI was consistent across reporters.

### Adolescent Report

Table 5 shows that OR Factor 2 of adolescent report was associated with observed behaviors in every instance except for father and adolescent antisocial at age 12, where there was only one factor. Only OB Factor 2 did not predict adolescent and father antisocial at age 14. OR adolescent report Factor 2 was also related to all survey reports across years. At age 14, both OB factors were related to RSA and RSA-R. Both OR factors were related to RSA and RSA-R except for Factor 2 and RSA.

### Mother Report

Mother reports were inconsistently related to observed father – adolescent interactions. At 10 years, mother report was not related to observations, although at 12 years OB Factor 1 was related to father prosocial behaviors, as were both OR Factors 1 and 2. OR Factor 2 was also related to adolescent prosocial behaviors. At 14 years, both the OR and OB Factor 2 were associated with father prosocial behaviors.

For participant reports, three partial correlations were significant: OR Factor 2 and internalizing, OR Factor 1 and externalizing, and OB Factor 2 and externalizing. OR Factor 2 at 10 years was also associated with internalizing and externalizing. Both the OB and OR Factor 2 were related to all participant report data,

Table 5. *Partial Correlations at p < .05, Geomin Oblique and Orthogonal Rotation Controlling for Gender of Child, Race, Income, and Other Factors Within Reporter*

| | Child factors | | Mother factors | | Father factors | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 |
| Age | | | | | | |
| 10 years | | | | | | |
| Observation | | | | | | |
| Father prosocial | | .26*** | | | .16* | |
| | | **.27*** ** | | | | |
| Father antisocial | −.14* | −.19** | | | | |
| | **−.14* ** | **−.30*** ** | | | | |
| Child prosocial | | .26*** | | | | |
| | | **.28*** ** | | | | |
| Child antisocial | | −.16* | | | | |
| | | **−.20** ** | | | | |
| Participant report | | | | | | |
| School engagement | | .25*** | | | | |
| (child report) | | **.31*** ** | | | | |
| Child internalizing | | −.21** | | | | |
| (child report) | | **−.28*** ** | | **−.22** ** | | **−.21** ** |
| Child externalizing | | −.28*** | | −.16* | | |
| (mom report) | | **−.28*** ** | **−.14* ** | | | |
| 12 years[a] | | | | | | |
| Observation | | | | | | |
| Father prosocial | .33*** | | .16** | | .15* | .12* |
| | | | **.16** ** | **.19** ** | **.15* ** | **.30*** ** |
| Father antisocial | | | | | | |
| Child prosocial | .28*** | | | | | .17** |
| | | | | **.13* ** | | **.21*** ** |
| Child antisocial | | | | | | |
| Participant report | | | | | | |
| School engagement | .31*** | | | | | |
| (child report) | | | | | | |
| Internalizing | −.33*** | | | | −.12* | |
| (child report) | | | | **−.12* ** | **−.12* ** | **−.12* ** |
| Externalizing | −.17** | | | | | |
| (mom report) | | | | **−.15** ** | | **−.13* ** |
| 14 Years | | | | | | |
| Observation | | | | | | |
| Father prosocial | | .19** | | .13* | | |
| | | **.32*** ** | | **.22*** ** | | |
| Father antisocial | | | | | | |
| | | **−.14* ** | | | | |
| Child prosocial | | .17** | | | | |
| | | **.27*** ** | | | | |
| Child antisocial | | | | | | |
| | | **−.12* ** | | | | |
| Participant report | | | | | | |
| School engagement | | .19** | | .11* | | |
| (child report) | | **.30*** ** | | **.13* ** | | |
| Child internalizing | | −.19*** | | −.13* | | −.16** |
| (child report) | | **−.35*** ** | | **−.21*** ** | | **−.12* ** |

Table 5. *Continued*

| | Child factors | | Mother factors | | Father factors | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 |
| Child externalizing (mother report) | | **−.16**** | | **−.14*** | | |
| Physiology | | | | | | |
| RSA | .20** | −.21** | .22** | −.26** | | −.16* |
| | **.20**** | | **.22**** | **−.24**** | | **−.19*** |
| RSA-R | .14* | −.22** | .17* | −.22** | | −.18** |
| | **.15*** | **−.19**** | **.17*** | **−.23**** | | **−.23**** |

*Note*: Partial correlations for the oblique rotation are in normal font. Partial correlations for orthogonal rotation are in boldface. RSA = respiratory sinus arrhythmia; RSA-R = RSA reactivity.

[a]There is no rotation for child report at 12 years because there is only one factor.

*$p < .05$. **$p < .01$. ***$p < .001$.

except OB Factor 2 and externalizing problems. Finally, at age 14, Factors 1 and 2 (both OB and OR) were all significantly related to RSA and RSA-R, with Factor 1 positively related and Factor 2 negatively related.

### *Father Report*

Only OB Factor 1 of father report at 10 years was related to any observational data (father prosocial). At 10 years, no father report factor was related to observational data; however, at 12 years, both OB and OR Factors 1 and 2 were related to father prosocial and Factor 2 (both OB and OR) was related to adolescent prosocial. For participant report, at each year OR Factor 2 was related to internalizing, with OB Factor 2 related to internalizing at 14 years. At 12 years, both OR and OB Factor 1 were related to internalizing, and OB Factor 2 was related to externalizing. Both OB and OR Factor 2 were related to vagal tone.

## Discussion

The most striking element from this exploration of FI measurement invariance is the difficulty in achieving invariance that indicates comparable constructs (i.e., strong invariance). Indeed, although FI latent constructs were invariant across gender within mother and father reports, in no other instance was such invariance evident. In addition to the lack of strong invariance, the number of factors varied across time and reporter. Furthermore, the original Hawkins et al. (2002) domains did not consistently (or even regularly) align with current findings. Indeed, although Items 3 and 5 (see Table 1) were in the same domain as Hawkins et al. there were several instances where items from other domains loaded highly with them. Items 2 and 7 (part of the same Hawkins et al. domain) were paired substantially in the same domain only for father and mother reports at age 12 and father report at age 14. These were not substantially paired for child responses. Taken together, these results suggest that domains of FI are more contextually based than research has previously conceptualized or operationalized. Domains at one point may not hold together at a later time, even when measures are taken only a few years apart.

Models often used by FI scholars are likely not well equipped to conceptualize the kinds of FI differences found in the current study. For example, Lamb et al.'s conceptualization (Lamb, Pleck, Charnov, & Levine, 1985, 1987) and Belsky's model of the determinants of parenting (Belsky, 1984; two frameworks commonly drawn on in FI research) do not explicitly consider the structural aspects of involvement domains, focusing primarily on levels of involvement. Indeed, Pleck's foundational reviews (Pleck, 1997; Pleck & Masciadrelli, 2004) treat FI's ''levels, sources, and consequences,'' to which ''structures'' could be added.

The current study suggests that theories that deal more directly with time (i.e., life course and other developmental theories) would add substantial value to FI theory building. In addition, theories based on symbolic interactionism may be particularly useful in accounting for multiple perspectives (or realities) within a family. Although Larson and colleagues (Larson & Richards, 1995; Larson, Richards, & Perry-Jenkins, 1994) have examined ''divergent realities'' of family members, they focused on mean differences rather than differences in how involvement domains are conceptualized.

In the next section, we discuss each component of the analysis and how attending to these elements moves theory building, data collection, and application efforts forward.

### *Father Involvement Over Time*

The findings of this study strongly caution against theoretical and data collection assumptions that FI factors are invariant over time. These findings have considerable implications for how FI dimensions are conceptualized and suggest a compelling line of research examining how FI evolves over time and across family members' perspectives. For instance, for the 10-year child report, ''act as friend'' loads on Factor 2 at .92 (OB), and ''make it easy for child to talk'' loads at 0.61. At 12 years, they load at 0.75 and 0.78, respectively, and at age 14 they load at 0.68 and 0.87, respectively (an almost total reversal). For this domain, the gradual decrease in ''acting as a friend'' and gradual increase in ''make it easy for child to talk'' speak of a parent – child relationship domain that is evolving from playmate to confidant. Thus, from a conceptual standpoint, it makes little sense to measure whether the domain of ''playmate'' is increasing over time, because the meaning of the domain may be transforming. Indeed, the general theoretical notion of evolving FI domains has received very little attention. When assessing FI across time, the typical consideration is whether items apply at various child ages (i.e., whether behaviors are manifest at different child ages) and not whether the domain underlying the items has changed.

Thus, our findings suggest that comparing mean differences across time, including modeling growth, should be handled with caution. One should first examine whether invariance holds over time or even whether there are the same number of factors over time. If factors are different, autoregressive models may be of use (Finkel, 1995). In these models, though, it must be acknowledged that the identical FI construct is not being controlled for from one time point to the next. Thus, it may not be possible to measure true change.

Although elements of FI domains in this study were variant across time, it is important to note that the 10-year domains likely form the basis for levels of the 14-year domains; that is, earlier domains likely form the foundations of levels in later domains. Although this is an untested hypothesis, it may be analogous to the foundation of a building. The foundation is not the same thing as what is built on top of it, yet to a large extent the foundation defines the properties of what is built on top. Latent transition analysis (L. M. Collins, Hyatt, & Graham, 2000) may be helpful in handling such models, in which profiles of FI can be identified at multiple time points with an examination of how membership in profiles at one time point may lead to membership in profiles at a later time point.

### *Father Involvement and Child Gender*

Our results also suggest that when parents respond to FI measures the domains are consistent across boy and girl children. This was not found for adolescent report, perhaps because of differential identification with the father, boys and girls in our sample appeared to view the domains of FI differently. This may help explain the mixed findings in research on differential FI for male and female children. Researchers should be aware that when children report FI, means across the genders may be incomparable, leading to erroneous conclusions about gender differences.

### *Father Involvement Across Reporter*

In like manner, variations found in factor structures across reporters may indicate that the same behaviors are interpreted differently by children and parents. For adolescents, ''encouragement'' and ''attending activities'' are highly indicative of Factor 1 at ages 10 and 14 (seemingly to make their own unique factor). This indicates that encouragement, for adolescents, is associated with parents supporting their activities. In contrast, encouragement and attending activities are not as strongly paired for parent reports (in particular within OB rotation).

Factors also have important substantive differences across reporters. For example, Factor 1 of child report at age 10 primarily deals with the father attending activities, whereas the parent Factor 1 is primarily about ''taking care of the child'' (most clearly seen in OB rotation). Thus, the children in our sample perceived a domain of father support rather than a domain of instrumental help. This reverses by age 14, however, when adolescents may begin to note instrumental care fathers provide and thus ''taking care'' begins to form part of a FI domain. It is interesting to note, though, that for father report at age 14 the unique domain of caregiving no longer appears.

This suggests that researchers should take great care in combining multiple FI reports. Summing or averaging items across reporters may merge statistically and conceptually distinct variables. Combining reports via second-order factor analysis (Bollen, 1989) or a bifactor model (see Yung, Thissen, & McLeod, 1999) may be appropriate. In these models what is shared across reporters is modeled while also accounting for unique aspects of each reporter. If, however, only what is shared among reporters is used, the unique perspectives of each reporter is lost. Furthermore, when interpreting the influence of FI from any one reporter, the factor structure should be noted, and care should be taken when generalizing results beyond the reporter.

### *Oblique Versus Orthogonal Rotation*

As was expected, the OR solution resulted in more cross-loadings than the OB solution (loadings $>0.30$), although, again, in ESEM all loadings were estimated. There were no instances of cross-loadings in the OB rotation, whereas there were 22 instances in the OR rotation. OB factors are therefore more clearly distinguished by factor loadings. It appears that most factors retain their substantive meaning across rotations (i.e., similar loading patterns). Notable exceptions include Factor 1 of father and mother reports at age 10.

Partial correlations are of conceptual and methodological import regarding OR and OB rotations. The considerable number of significant correlations with OB factors that dropped out when controlling for the other factor(s) leads to a substantial concern with overlap. Furthermore, there were several instances when neither factor of the OB rotation was significant when both were entered in the model, whereas one or both were significant when not controlling for the other, likely indicating multicollinearity.

Thus, although allowing for correlations provides clearer factor interpretation, in doing so, the overlap may be so substantial that they essentially become the same measure. Attempting to analytically treat various parts of FI as separate thus becomes highly problematic with OB. OR was better able to separate distinct FI dimensions and may be preferable despite the potential loss of factor structure clarity.

Another important point concerns the 30 instances in which both the OB and OR factors are significantly related to a correlate. In all but three of these instances the OR partial correlation is equal to—or, in most cases, greater than—the OB partial correlation. Furthermore, there were eight instances when the OR factor was significantly related to a correlate when its OB counterpart was not. There were only three instances of the reverse case. This pattern is evidence for greater criterion validity of OR factors.

Conceptually, when FI factors are not allowed to correlate, the factor analysis identifies domains of behavior that function independently of each other; that is, the level of FI in one domain provides no indication of the level in another domain. This also means there is no global variable related to them both (as was assumed in the original Hawkins et al., 2002, study of the IFI). Whether to allow correlations is a substantive question, but it can become, as was seen here, a statistical one as well. That is, when factor analysis produces highly correlated factors, despite conceptual differences there is little practical difference. Again, although not allowing factors to correlate may obscure some of the distinct conceptual differences, this may be optimal when identifying how various domains differentially relate to antecedents or outcomes.

### *Criterion Validity and Reporter*

Regarding reporters, partial correlations reveal a clear pattern of greater criterion validity for adolescent report with 23 significant partial correlations compared to 15 and 10 significant partial correlations for mother and father reports, respectively. The greater portion of this disparity comes from the observation correlates: Mother report was not related to any observational measures at years 10 or

12, and father report was related to far fewer observational measures than adolescent report. It may be that, compared to parents, adolescent responses reflect the global father–adolescent relationship. Adolescents may respond to items more favorably if the overall father–adolescent relationship is good than if it is poor, reflecting a sentiment override in their responses.

The findings also suggest that new measures of FI should capture domains salient to and even defined by the adolescent. The creation of FI domains thus far has been largely father centric in that the father's perspective has been the focus in defining their involvement.

It is important to note that Factor 2 was associated with far more observational and participant report correlates than Factor 1, with Factor 2 marked by the items ''make it easy for child to talk to you'' and ''act as a friend.'' Factor 1 was typically marked by attendance at activities, helping with homework, and/or taking care of the child and was rarely related to observational and participant reports. Factor 1 may be considered as comprising more instrumental FI activities that do not deal as directly with the father–adolescent affective relationship. It may be that the father's antisocial and prosocial behaviors is an observed indicator of Factor 2. If so, child reports may indeed be considered to have greater criterion validity.

One reason for far fewer significant correlates with Factor 1 may also be the lower validity of the items for this factor. Indeed, in the OR rotation for father report at age 10 only one item loaded above .30. In some instances, the items may be a good measure of Factor 2 but a poorer measure of Factor 1. This again stresses the critical importance of examining measurement invariance assumptions since how well domains are captured by items may vary.

### *Physiologic Data*

The relationship between physiologic data and FI was consistent across reporters. Adolescent and mother report demonstrated the most validity, with both Factors 1 and 2 being significantly related with RSA and RSA-R. Father-report Factor 2 was associated with both as well, although neither Factor 1 nor 3 was significantly related to vagal tone.

The positive association between Factor 1 and RSA and RSA-R was consistent across mother and child reports, with greater FI associated with a more relaxed state. This factor is associated with attending activities and ''taking care'' of the adolescent. Involvement in these more indirect activities may make the child feel more comfortable in the presence of the father.

Conversely, and contrary to initial conjecture, higher levels of Factor 2 (ease of father–adolescent communication) were associated with lower RSA and greater RSA withdrawal (lower RSA-R), indicating a less relaxed state of the child. Thus, when fathers make it easy for children to talk to them the adolescent may orient more toward the father and prepare to engage in an active exchange (i.e., vagal withdrawal). It is important to note that moderate decreases in RSA are hypothesized as adaptive when engaging in certain social tasks (Porges, 2011). It may also be that these fathers engage in more intimate topics and the adolescent is responding to the possibility of topics that may be more personal. Although much future research needs to be done in this area, it is clear that extracted factors demonstrate criterion validity with objective, physiologic activity, and did so more for adolescent and mother reports than father report.

### *Limitations*

One key limitation of the current analyses is the limited number of FI items available. With more items, additional involvement factors would likely have been identified. Still, the findings are of substantial import regarding items that were measured. Indeed, larger scale studies often use reduced-size measures, and it is significant to note that, in the reduced-size scale used in the current study, measurement invariance was found to be of critical concern.

A second limitation is that we did not examine invariance by race/ethnicity. This will be particularly important to consider when investigating substantive questions regarding such differences. This also speaks to the relative lack of diversity in the current sample, in which only African Americans and Caucasians were represented. Measurement invariance also needs to be explored in other age groups and with other FI measures.

### *Full Versus Partial Invariance*

An area we did not explore is that of partial measurement invariance. Some researchers have argued that there are occasions when not all loadings or intercepts need to be constrained in order to make cross-group or over-time comparisons; however, there are few guidelines concerning partial invariance, and it is generally used in an ''exploratory, iterative, post hoc practice, and so it is subject to capitalization on chance'' (Vandenberg & Lance, 2000, p. 37). Indeed, the order in which one tests invariance of individual loadings or intercepts may alter which loadings or intercepts make for a worse model fit. If partial invariance is used, the question remains whether the means are conceptually comparable rather than simply statistically comparable (i.e., there are sufficient degrees of freedom to estimate the model). This question can be answered only on a case-by-case basis with close examination of model fit and conceptual considerations. Even if partial invariance is assumed, it is important to acknowledge the potentially important finding that FI may have a somewhat different nature across contexts.

### *Model Trimming*

In the current analyses we also did not attempt to ''trim the model.'' When measures are not invariant, it may be possible to eliminate certain items that vary substantially over time or across reporters; that is, the scale would be reduced to those items that do display invariance. Although in many instances this may be an acceptable alternative, it is important to note that this process eliminates FI information and therefore provides a less holistic view of the underlying construct. Indeed, the need to trim items to achieve measurement invariance likely means the same construct does not exist across contexts, although, given certain theoretical or conceptual reasoning, this may be justified.

### *Conclusion*

The overall purpose of the current study was to provide the rationale for and an empirical example of the role of measurement invariance in conceptualizing FI. Child age, gender, and reporter are simply examples of numerous factors that may influence the nature (or perceived nature) of FI. Taken as a whole, the results of the empirical example suggest that much greater attention should be paid to how FI may differ over time and across reporters. This study provides a window into a hitherto unexplored area of fatherhood theory and research. It steers the study of FI away from a time-invariant and father-centric focus to a view of how perceptions of father involvement evolve over time for each family member and how those perceptions matter to family and child well-being.

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## Appendix
## Means and Standard Deviations

| | Child Report | | Mother Report | | Father Report | |
|---|---|---|---|---|---|---|
| Age and item | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| Age 10 | | | | | | |
| 1. Attend activities | 4.16 | 1.07 | 4.37 | 0.82 | 4.31 | 0.75 |
| 2. Read books | 2.96 | 1.20 | 3.37 | 1.14 | 3.35 | 1.06 |
| 3. Encouragement | 4.64 | 0.67 | 4.63 | 0.64 | 4.54 | 0.65 |
| 4. Take care of | 4.38 | 0.99 | 3.94 | 0.97 | 4.10 | 0.89 |
| 5. Act as a friend | 4.23 | 0.98 | 3.89 | 0.95 | 4.05 | 0.90 |
| 6. Work hard | 4.45 | 0.88 | 4.62 | 0.79 | 4.50 | 0.78 |
| 7. Homework | 4.04 | 1.05 | 3.70 | 0.97 | 3.69 | 0.95 |
| 8. Make it easy for child to talk to you | 4.20 | 0.96 | 4.12 | 0.87 | 4.21 | 0.80 |
| Age 12 | | | | | | |
| 1. Attend activities | 3.99 | 1.10 | 4.07 | 0.93 | 4.20 | 0.78 |
| 2. Read books | 2.33 | 1.18 | 2.91 | 1.19 | 2.85 | 0.98 |
| 3. Encouragement | 4.46 | 0.80 | 4.40 | 0.81 | 4.37 | 0.72 |
| 4. Take care of | 4.20 | 1.03 | 3.82 | 1.01 | 3.92 | 0.92 |
| 5. Act as a friend | 3.93 | 1.09 | 3.68 | 0.99 | 3.93 | 0.90 |
| 6. Work hard | 4.47 | 0.98 | 4.57 | 0.85 | 4.42 | 0.83 |
| 7. Homework | 3.73 | 1.19 | 3.45 | 1.11 | 3.52 | 0.91 |
| 8. Make it easy for child to talk to you | 3.78 | 1.12 | 3.93 | 1.01 | 4.05 | 0.82 |
| Age 14 | | | | | | |
| 1. Attend activities | 3.83 | 1.09 | 3.92 | 0.90 | 4.04 | 0.74 |
| 2. Read books | 1.99 | 1.00 | 2.30 | 1.05 | 2.43 | 0.88 |
| 3. Encouragement | 4.22 | 0.89 | 4.29 | 0.80 | 4.26 | 0.69 |
| 4. Take care of | 3.93 | 1.05 | 3.74 | 1.01 | 3.88 | 0.86 |
| 5. Act as a friend | 3.55 | 1.18 | 3.55 | 0.94 | 3.67 | 0.92 |
| 6. Work hard | 4.48 | 0.91 | 4.49 | 0.90 | 4.46 | 0.71 |
| 7. Homework | 3.15 | 1.24 | 3.15 | 1.11 | 3.20 | 0.92 |
| 8. Make it easy for child to talk to you | 3.50 | 1.14 | 3.74 | 0.97 | 3.94 | 0.82 |