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A Self-Report Measure of Pubertal Status: Reliability, Validity, and Initial Norms

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Puberty is a central process in the complex set of changes that constitutes the transition from childhood to adolescence. Research on the role of pubertal change in this transition has been impeded by the difficulty of assessing puberty in ways acceptable to young adolescents and others involved. Addressing this problem, this paper describes and presents norms for a self-report measure of pubertal status. The measure was used twice annually over a period of three years in a longitudinal study of 335 young adolescent boys and girls. Data on a longitudinal subsample of 253 subjects are reported. The scale shows good reliability, as indicated by coefficient alpha. In addition, several sources of data suggest that these reports are valid. The availability of such a measure is important for studies, such as those based in schools, in which more direct measures of puberty may not be possible.

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INTRODUCTION

The central marker of the early adolescent period, involving the transition from childhood into adolescence, is the initiation of physical changes associated with puberty. Over the course of puberty, young people make the transition from looking like children to looking like adults (Petersen and Taylor, 1980). These physical changes and the underlying hormonal changes have been hypothesized to shape most aspects of early adolescent development and experience, from cognitive performance to self-perceptions and sociosexual behavior (Petersen and Spiga, 1982). Thus, researchers interested in exploring the potential relationships between pubertal maturation and other aspects of development have become concerned with the measurement of pubertal change.

The measurement of pubertal status is complicated by a number of factors, including the complex nature of the pubertal process, individual differences in the pattern of pubertal change (Eichorn, 1975), lack of precise measurement techniques, and problems with securing permission to use the most precise measures available. Interested readers are referred to other sources for information on pubertal change (e.g., Brooks-Gunn and Warren, 1985; Grumbach *et al.*, 1974; Petersen and Taylor, 1980; Tanner, 1962, 1974). In this paper, we review pubertal measures and then describe a measure of pubertal change that appears to address practical concerns while retaining adequate psychometric properties.

THE MEASUREMENT OF PUBERTAL CHANGE

Although sometimes thought of as an event, puberty is actually a set of biological processes producing changes in young people's reproductive physiology and physical appearance (Petersen and Taylor, 1980). Two major types of changes occur: (1) endocrine changes, primarily involving increases in gonadal hormones (androgens, estrogens, and progesterone); and (2) somatic changes, involving changes in body size and shape, along with the development of secondary sex characteristics. Endocrine changes presumably underlie the somatic changes, but the somatic changes may be more strongly related to social and psychological phenomena because of their visibility. In our society, as in most others, the appearance of adult characteristics becomes linked with expectations for adult behavior.

Pubertal status can be assessed on both the endocrine and the somatic level. The choice of measures depends, however, on both conceptual and practical considerations. Conceptually, one must consider the reason for including a measure of puberty. If the research question concerns internal cognitive or mood processes covering relatively short spans of time, endocrine

measures may be essential. On the other hand, if the question pertains to social responses to pubertal maturation, the visible (somatic) manifestations of pubertal change are likely to be more important. The paucity of previous research on biobehavioral interactions in early adolescence gives us little upon which to base hypotheses. Given this state, and the likelihood that we cannot use both kinds of measures, research designs and choice of pubertal measure need to be based upon the theoretical assumptions and the nature of the research questions.

Although endocrine measures may be thought to provide the most direct assessment of pubertal change, the requirements of endocrine assessments, the number of hormones involved with puberty, and the practical problems of obtaining valid measures are substantial (e.g., Nottelmann *et al.*, 1987). Furthermore, if the research question focuses more on the somatic manifestations of pubertal change, hormone measures may not be appropriate. If the research question requires only an index of status within the pubertal process, this information can be gained more easily by assessment of somatic growth.

Somatic assessments of pubertal maturation have focused on markers such as the adolescent growth spurt and the development of secondary sex characteristics. The adolescent growth spurt is indexed by height or weight (although more accurately by height). Data from the several longitudinal growth studies in this country have shown predictable patterns in height change that can be represented by a statistical function (Bock *et al.*, 1973; Thissen *et al.*, 1976). One useful index obtained from the process of estimating parameters with this function is age at peak height velocity (i.e., the time of most rapid growth) in the adolescent growth spurt. Composite measures of height and weight such as the ponderal index (Bayer and Bayley, 1959; Tanner, 1962) have also been used to index developmental status and relative size. Height and weight are relatively easy to assess, making these measures attractive. Their link to pubertal status, however, may be more distal than is desirable, depending on the research question. More research is needed to establish the extent and nature of variation in growth rate for pubertal status.

Growth in secondary sex characteristics is used as a pubertal index in the Sexual Maturation Scale developed by Tanner (1962), following the work of Reynolds and Wines (1948, 1951). This scale is based on development of pubic hair, breasts, and male genitalia; in each case, ratings range from immature to fully developed. Several studies have demonstrated that development of these characteristics using the scale is related to endocrine increases (Gupta *et al.*, 1975), height (Tanner, 1974), and other pubertal changes (Marshall and Tanner, 1969, 1970). Facial hair, axillary hair, body odor, and body shape are other aspects of pubertal change that have been indexed (Bayer and Bayley, 1959).

The Sexual Maturation Scale (SMS) was designed to be used by a trained rater, typically a pediatrician, assessing pubertal development in the nude

child. This direct method of assessment may be objectionable to parents, school personnel, and occasionally the children themselves. An alternative is to use self-reports from the boys and girls. Two research groups have developed self-report versions of the SMS (Duke *et al.,* 1980; Morris and Udry, 1980). Both versions require that adolescents rate their own development relative to figure drawings or photographs of secondary sex characteristics in the five stages of development. Although reliability of these methods has not been examined, each has been compared with the usual Tanner method of rating. Morris and Udry (1980) reported correlation coefficients ranging from .59 (for boys' genital development) to .81 (for girls' breast development). Duke *et al.,* (1980) reported kappa coefficients ranging from .81 to .91 between adolescents' reports and physicians assessments of secondary sex characteristics.

School personnel may find the visual depictions of secondary sex characteristics inappropriate for use in a school setting, as we have noted previously (Petersen *et al.,* 1983). In this study, for example, school district representatives (i.e., school board or school superintendent) would approve neither the use of direct observations nor the use of visually depicted sexual maturation ratings. Therefore, we developed a verbal method of assessing pubertal status in the context of an individual interview.[5] As we noted in a preliminary report (Petersen *et al.,* 1983), this method requires the young adolescent to report the degree of his or her own pubertal change on a number of relevant characteristics. Because of our research questions, our focus was on the overall process of puberty, with all its components and variations, rather than on change in any single characteristic. This approach is in the psychometric tradition of latent trait assessment (e.g., Lord and Novick, 1968) and follows the usual conventions for measuring a latent or unobserved trait (i.e., pubertal change).

Verbal self-ratings circumvent many of the objections raised by parents and school personnel to more traditional somatic measures, but are clearly more subjective measures, potentially subject to errors of reporting and social desirability effects. Therefore, validation of these measures is especially crucial. Apart from showing good internal consistency, a measure should meet several criteria. First, it should correlate with external (more objective) measures of pubertal status. Second, the scores should reflect the sequence and timing of pubertal events observed when more objective measures are used. Finally, repeated measurements with the instrument should show relatively few cases of pubertal regression, or *decreases* in scores between successive times of measurement; such decreases are contrary to the

[5]The interview questions have also been adapted for a paper-and-pencil questionnaire.

growth process and suggest unreliability in the self-ratings. Our investigations of instrument validity were organized around these criteria.

METHOD

Design

The Early Adolescent Study (e.g., Petersen, 1984) utilized a longitudinal cohort-sequential design (Baltes, 1968; Schaie, 1965) involving the repeated measurement of two cohorts of young adolescents. Participants were interviewed twice annually over the course of a three-year period from sixth to eighth grade. Young adolescents also participated in twice-annual group-testing sessions involving the completion of various paper and pencil measures of cognitive, psychological, and social development. (A more complete description of the study is provided in Petersen, 1984).

Sample

Two successive birth cohorts of young adolescents were sampled from two suburban school districts. The young adolescents were primarily Caucasian and from middle to upper-middle class families. (More information on the demographic characteristics of this sample is provided in Richardson *et al.*,1984). The young adolescents in each cohort showed relatively little variation with respect to age for grade, with a standard deviation of three months; boys and girls were not different in chronological age, averaging 11.5 years in January of sixth grade.

Students were randomly selected from class lists at the beginning of sixth grade. Letters were sent to the students and their parents describing the study and requesting participation. Twenty percent of the families so contacted refused participation or failed to return consent forms, with little variation in this percentage by cohort or school district.

The initial sample consisted of 335 young people. Six percent of the sample dropped out before the conclusion of data collection three years later; another 4% of the subjects moved away from the metropolitan area. Subjects lost from the study, through dropout or moving, have not been found to differ significantly from the rest of the sample on any variable. In addition, the study sample was compared both at sixth and at eighth grades with the entire population from which they were drawn on a measure of self-image, involving nine scales. Again, the study sample did not appear to be different.

In the present report, we have used a subsample of subjects identified for use in longitudinal analyses. Ths subsample (n = 253) was present for

at least two-thirds of the group assessments *and* interviews. It did not differ from the full sample on any measures.

The Measure of Pubertal Development[6]

One section of the interview included questions about puberty. The section began with the statement, "Now I'm going to ask you some questions about physical development." After an initial time in Cohort I at which a rather global question about pubertal change was asked, and a second time in which we used a dichotomous response scale, we began asking whether there had been no development, development had barely begun, development was definitely underway, or development was already completed on each of several characteristics. These characteristics included growth spurt in height, pubic hair, and skin change for both boys and girls; facial hair growth and voice change in boys only; and breast development and menarche in girls only.[7] Because we asked these questions in the context of an interview, we were able to respond to questions and clarify items (e.g., growth spurt). These sets of items form scales consisting of five items for each gender, coded on a four-level ordinal response scale. An overall pubertal development score was computed by summing across the five items to obtain a total score; the sum of the scores on the five indicators was divided by five in order to preserve the original $(1-4)$ metric.

RESULTS

Table I shows the means and standard deviations for each characteristic at each time of assessment. Since there were no cohort differences on these assessments, data were summed across cohorts. Note that for each characteristic the group mean invariably increases over time, as would be expected,

[6]Further information on the Pubertal Development Scale (PDS), including copies of the interview and questionnaire versions, information on scoring, and a description of the categorization procedure, may be obtained by writing to the first author.

[7]We also included a question about the timing of the spurt in foot growth. Although this question worked with boys, it did not for girls. This is probably because the foot is often the first part of the body to begin growing, making it a more distant event for many girls. In addition, our definition of the spurt in foot growth ("Can you remember a time when your shoe size changed by more than two sizes within a six-month period?") may have been too gross a measure for girls who end up with small feet. (To a lesser extent, this same problem exists with the detection of a growth spurt in height: it may be imperceptible in very short individuals.)

Table I. Means and Standard Deviations of Pubertal Indices for Boys and Girls[a]

	Grade-season				
Index[b]	6-Spring	7-Fall	7-Spring	8-Fall	8-Spring
Boys					
Body hair	2.08 (.79)	2.27 (.80)	2.51 (.75)	2.77 (.69)	3.01 (.68)
Voice change	1.40 (.54)	1.62 (.71)	1.75 (.92)	1.98 (.92)	2.47 (1.03)
Skin change	1.44 (.54)	1.67 (.67)	1.68 (.75)	1.92 (.87)	2.19 (.92)
Growth spurt	1.52 (.77)	1.80 (.87)	1.89 (.87)	2.11 (.97)	2.63 (.86)
Facial hair	1.15 (.36)	1.36 (.56)	1.38 (.61)	1.60 (.82)	1.94 (.78)
Girls					
Body hair	2.14 (.79)	2.28 (.83)	2.69 (.89)	2.96 (.89)	3.30 (.67)
Breast change	2.28 (.75)	2.29 (.70)	2.69 (.83)	2.96 (.77)	3.15 (.72)
Skin change	1.61 (.86)	1.81 (.87)	1.95 (1.06)	2.15 (1.07)	2.47 (1.21)
Growth spurt	2.02 (1.17)	2.25 (1.11)	2.43 (1.15)	2.77 (1.14)	3.20 (.95)
Menarche[c]	1.63 (1.23)	1.72 (1.30)	2.14 (1.46)	2.84 (1.47)	3.23 (1.32)

[a]Data from sixth-grade spring and seventh-grade fall are from Cohort II only (N = 118); for all other times of measurement, data from the two cohorts were pooled (N = 253).
[b]Indices coded on a 4-point scale, were 1, *no development;* 2, *beginning development;* 3, *additional development;* and 4, *development already past.*
[c]Coded dichotomously, with 1, *premenarcheal;* and 4, *postmenarcheal.*

given increasing pubertal growth. Moreover, if we compare the level of development reported for the various indicators at each time of measurement, we see that they reflect the sequencing of pubertal events as outlined by Tanner (1972), such that pubic hair growth is reported earlier than other characteristics in boys, with the growth spurts substantially later and facial hair growth the latest change. Pubic hair and breast development are reported earlier in development by girls, with the growth spurt later. Menarche, a dichotomous event, is later than the growth spurt until the eighth grade, when many girls are postmenarcheal. In general, then, the nature of the reported changes over time as well as their sequence accords well with the developmental patterns found by Marshall and Tanner in their data (1969, 1970).

Reliability

Consistency

The reliability of the PDS was assessed in terms of internal consistency as indicated by coefficient alpha. Item-total correlations as well as alpha coefficients for each time of assessment are shown in Table II. The alpha coefficients range from .68 to .83, with a median of .77. These are quite respectable alphas, especially since each is based on only five items. (The median

Table II. Item-Total Correlations and Alpha Coefficients[a] of the Puberty Scale[b]

Index	Grade-season				
	6-Spring	7-Fall	7-Spring	8-Fall	8-Spring
Boys					
Body hair	.48	.50	.52	.48	.37
Facial hair	.47	.46	.39	.50	.55
Voice change	.53	.48	.57	.67	.57
Skin change	.48	.58	.32	.58	.56
Growth spurt	.34	.49	.44	.59	.44
Alpha	.72	.74	.68	.78	.73
Girls					
Body hair	.42	.60	.61	.60	.72
Breast growth	.58	.63	.69	.69	.68
Menarche	.51	.52	.35	.42	.57
Skin change	.47	.48	.49	.44	.51
Growth spurt	.38	.53	.56	.66	.57
Alpha	.76	.78	.78	.80	.83

[a]Standardized item alphas.
[b]Sixth-grade spring and seventh-grade fall data were available for Cohort II only (N = 118); other entries are based on total longitudinal sample (N = 253).

alpha corresponds to an alpha of .88 if there had been ten items.) Internal consistency is, of course, highly susceptible to response set. Indeed, these estimates of internal consistency might even be higher than those that would be obtained if the physical characteristics had been assessed directly. What the alphas tell us is that young adolescents were consistent in their reports of pubertal change across characteristics.

Pubertal Regressions

A second approach to assessing the reliability of the PDS self-ratings was to analyze instances of apparent regression, where adolescents' ratings of their level of development decreased from one interview to the next. Our primary interest was in the proportion of ratings showing a decrease. Because the adolescents made five ratings (one for each pubertal indicator) at each time of measurement, the proportion of "regressive ratings" provides a more sensitive measure of instrument reliability than the proportion of individuals showing regressions.

Of the ratings made by boys, 9.8% involved decreases (regressions) from the previous time of measurement. The corresponding figure for girls was 6.4%. Thus, boys reported half again as many regressed ratings as did girls. The two cohorts did not differ in the proportion of regressions.

Table III. Percentage of Regressions in Self-Ratings by Index and Sex

	Boys (%)		Girls (%)
Body hair	7.5	Body hair	5.0
Skin change	12.8	Skin change	10.7
Growth spurt	11.9	Growth spurt	8.1
Facial hair	9.0	Menarche	0.2
Voice change	8.6	Breast growth	6.2

A more informative way to examine the data is to ask with which indicators the regressions occur. Thus, the percentage of regressive ratings was computed separately for each indicator for boys and girls (Table III). In both sexes, the highest percentages of regressions were observed with ratings of skin change (12.8% for boys; 10.7% for girls) and growth spurt (11.9% for boys; 8.1% for girls), suggesting that self-ratings of development on these characteristics may be less reliable (and less valid) than ratings on the other characteristics. It is somewhat reassuring that skin change accounts for the highest percentage of regressions since this index is not developmental in the same sense as the others; that is, for most adolescents acne is a temporary phase that "regresses" eventually for almost all young people. The regression rate was extremely low for menarche. This result is probably a function of the relatively unambiguous nature of this pubertal event and also of the dichotomous coding system used for the menarche item. (With two response categories, there is only one way of "regressing"; with four response categories, there are six ways of regressing.)

Thus, the regressions in pubertal status are generally minimal, with variations due to the indicator used. In one study (Dorn, 1987, personal communication) using observed and self-reported SMS ratings, there were no regressions on observed ratings except breast development (1%), where they are actually possible. In the self-reported SMS ratings, the regression rates were 4.1% for boys' genital ratings, 7.8% for girls' breast ratings, and 6.1% and 0% for boys' and girls', respectively, pubic hair ratings. These results compare very favorably to those just reported on the comparable PDS items.

Validity

Studies are currently underway that will provide more information about the relative validity and usefulness of the PDS as compared to the versions of the SMS that use pictures or drawings. As noted earlier, the participating schools would not permit use of either physician ratings or self-ratings using drawings or pictures, precluding their use for validation as well as actual meas-

ures. A recent report (Brooks-Gunn *et al.,* 1987) finds high correlations between a questionnaire version of the PDS and physician ratings (.61 – .67). The correlations between SMS self-ratings and the PDS were even higher (.72 – .80). Thus, the criterion validity of the scale is as high as it can be given the upper limit set by reliability (especially alphas).

Interview Ratings

Validity of the PDS was assessed by comparison to interviewer ratings of the child's pubertal status. Interviewers used a global index of pubertal status on which they rated each adolescent at the end of each seventh- and eighth-grade interview. Their information obviously included that just reported by the young adolescent, but interviewers also had the opportunity to observe some characteristics, such as facial hair or its absence, which could be erroneously reported by the adolescent.[8] Correlations between interviewer ratings and the overall pubertal scores based on adolescent self-reports ranged from .41 to .79, with a median correlation of .70. The correlations were lower with boys, particularly at the youngest ages. Nevertheless, the agreement between adolescent and interviewer was fairly high in most cases.

Age at Peak Height Velocity

In one of the school districts, we had available to us the annual measurements of height and weight from kindergarten through eighth grade. These measurements had been obtained at the same time each year by the same school nurse. We fit the objectively measured height data to a function obtained from the several major growth studies conducted in this country in order to obtain parameters of the adolescent growth spurt (Thissen *et al.,* 1976). One parameter, age at peak height velocity (the age at which an adolescent grows fastest), is especially relevant as a measure of pubertal timing. The average age at peak height velocity was 13.8 years for boys and 11.8 years for girls; these values are .8 year older than other data, with a similar standard deviation (e.g., Thissen *et al.,* 1976), suggesting that this sample matured somewhat later than others. Such a result has also been obtained in other current studies of upper-middle class youth (e.g., Brooks-Gunn and Warren, 1985). Age at peak height velocity was then correlated with adolescents' scores on the PDS (i.e., the average of the five indicators) at each time of measurement.

[8]Interviewers were occasionally surprised by a young man asserting that he had hair on his face when none could be observed. Probably the light was too poor.

Correlations between the estimate of age at peak height velocity and scores on the PDS range from $-.40$ to $-.66$ for boys, with a median r of $-.55$, and from $-.46$ to $-.65$ for girls, with a median r of $-.53$. The magnitude of the correlations indicates a strong relationship between self-reported pubertal status and age at most rapid growth. As expected, the correlations are negative, because at a given time of measurement, adolescents with more advanced pubertal status would be those who matured earlier than the others and had reached their time of most rapid growth at a younger age.

The pattern of correlations over time also makes sense, given what we know about the usual timing of pubertal events. According to the age norms established by Marshall and Tanner (1969, 1970), most boys show few pubertal changes until they are about 12 years old, in contrast to girls, who first show changes a year or two earlier. Thus, prior to seventh grade, even early maturing boys are likely to be prepubertal. Lower variation in sixth-grade pubertal status (seen on most indicators) produces lower variability in pubertal scores that would, in turn, attenuate correlations with age at peak height velocity. Therefore, it is not surprising that the lowest correlation for boys ($r = -.40$) is at sixth grade. In seventh and eighth grades, the correlations are higher ($r = -.54$ to $= -.66$) because by seventh grade more boys are becoming pubertal, creating variability in self-reported pubertal scores. Similarly, in girls, the correlation between pubertal status and age at peak height velocity is higher in sixth and seventh grades ($r = -.52$ to $-.65$) but drops in eighth grade ($r = -.46$). The drop probably occurs because many girls are completing puberty by this age, and the resulting low variability in reported status attenuates the correlation with age at most rapid growth. Thus, the nature of correlations over time and across sex varies in a sensible way relative to the growth process. These correlations also compare favorably with correlations obtained in another study between age at peak height velocity and pubertal maturation as assessed by observed changes in secondary sex characteristics (Petersen, 1979).

The pubertal status ratings have also been examined by pubertal timing groups: early, average, and late maturers. In this study, age at peak height velocity was trichotomized to produce early, average, and late pubertal developers (Petersen and Crockett, 1985). Development on each pubertal status indicator was compared by timing group for boys and girls. These analyses demonstrated that earlier maturers of both genders are more advanced on each characteristic at each time of assessment than are later maturers.

Summary

Thus, this self-report measure of pubertal status appears reliable and valid, as assessed in a variety of ways. First, the measure reveals changes

Table IV. Correlations Between Total Puberty Score and Assigned Pubertal Status Category[a]

Group	Grade-season				
	6-Spring	7-Fall	7-Spring	8-Fall	8-Spring
Boys	.27	.83	.74	.88	.85
	(48)	(55)	(105)	(109)	(107)
Girls	.80	.84	.79	.83	.53
	(57)	(58)	(129)	(123)	(133)

[a]Numbers in parentheses are sample *N*s. Sixth-grade spring and seventh-grade fall data were available only for Cohort II boys and girls; the rest of the entries are based on the total longitudinal sample ($N = 253$).

on each characteristic that vary over time and relative to one another in patterns comparable to those found with more objective data. Second, cases of pubertal regression (i.e., where scores decrease from one time to the next) are relatively rare and occur with greatest frequency with skin change, a pubertal characteristic that normally declines. Third, the adolescents' self-reports are related to those of the interviewer in systematic and reasonable ways. Finally, this measure of pubertal change shows predictable associations with objectively measured changes in height.

Pubertal Status Categories

Thus far, we have described a continuous measure of pubertal status for young adolescents—the total score based on self-rated development on five physical characteristics. For some research purposes, however, it may be more desirable to have a categorical classification. There are times, for example, when the research question would call for classification of young adolescents into three categories: prepubertal, pubertal, and postpubertal. The data from the PDS enabled us to develop a classification system with five levels: prepubertal, early pubertal, midpubertal, late pubertal, and postpubertal. (Of course, we would not expect all five categories to be represented at all ages for both boys and girls.)

Several sets of analyses were conducted to examine the utility of the five status categories. The first set of analyses revealed that adolescents assigned to lower status categories reported less development on each of the pubertal characteristics, including the indicators not used in assigning boys and girls to status categories (skin change and growth spurt), than did adolescents assigned to higher categories.

A second test of the status classification system was to correlate the overall (continuous) puberty scores discussed earlier in this paper with the status category scores. With few exceptions, the correlations were quite high (Table IV), indicating that the status classification system largely preserved

Table V. Frequency Distributions of Boys and Girls Across Pubertal Categories[a]

	Grade-season				
Category	6-Spring	7-Fall	7-Spring	8-Fall	8-Spring
Boys					
1 = Prepubertal	17%	11%	11%	3%	2%
2 = Early pubertal	60%	51%	44%	35%	13%
3 = Midpubertal	23%	36%	38%	49%	57%
4 = Late pubertal	0%	2%	7%	13%	27%
5 = Postpubertal	0%	0%	0%	1%	1%
X (SD)	2.06 (.64)	2.29 (.69)	2.41 (.77)	2.74 (.75)	3.12 (.71)
Girls					
1 = Prepubertal	5%	9%	3%	1%	0%
2 = Early pubertal	16%	7%	5%	2%	0%
3 = Midpubertal	58%	60%	54%	35%	25%
4 = Late pubertal	18%	21%	29%	43%	45%
5 = Postpubertal	4%	3%	9%	19%	30%
X (SD)	2.98(.83)	3.03(.88)	3.36(.83)	3.76(.81)	4.05(.74)

[a]Data for sixth-grade spring and seventh-grade fall are from Cohort II only (N = 113); otherwise, the two cohorts were pooled (N = 240).

the ordering emerging in the aggregate puberty scores. The exceptions are for boys in sixth grade and girls in the spring of eighth grade. These correlations are likely to be lower due to decreased variation in pubertal status among sixth-grade boys and eighth-grade girls.

Thirdly, the frequency distribution of categories by gender and time of assessment (Table V) reveal that the distributions shift to higher categories of pubertal status for each time of assessment for boys and girls. Furthermore, girls are ahead of boys by about a year and a half, again in accordance with established age norms.

Finally, we examined regressions in pubertal status categories, in a manner comparable to that reported earlier for the pubertal ratings. Only 3% of the girls' ratings dropped a category from one assessment time to the next. For boys, however, 16% of the categorical statuses regressed. A total of 55% of these regressions were from Category 3 to 2, suggesting that these categories are not well differentiated. (Indeed, the algorithm involves only an arbitrary cut point in a continuous sum to differentiate these two.) Therefore, the categories appear to provide an excellent way of portraying the pubertal status of girls. For boys, the categories appear slightly less stable than individual characteristics, or their sum.

DISCUSSION

This paper describes the Pubertal Development Scale (PDS), a self-report measure of pubertal changes. The PDS may be used to produce both

a continuous score of pubertal change and a five-level categorical classification, ranging from prepubertal to postpubertal. Within appropriate limits, the measure seems to have desirable psychometric properties and to be valid.

A self-report measure such as the PDS is likely to be useful if the researcher is interested in a rough assessment of pubertal status, and more direct measures (e.g., ratings based on direct observation of the nude child) are not acceptable to the study participants or to those responsible for the context in which the study is to take place (e.g., school personnel). The measure is most appropriately used in longitudinal studies in which the objective is to track young people's pubertal development over several years, or in cross-sectional studies in which a rough estimate of pubertal status will be adequate for the purposes of the investigator. Those with interest in a particular aspect of pubertal change (e.g., the height spurt) would be well advised to focus on that particular change rather than using a global puberty measure.

In our own longitudinal study this measure has enabled us to examine the social stimulus value of pubertal changes in terms of their meaning and consequences for adolescents and significant others who may react to these changes (see, for example Clausen, 1975; Petersen, 1983; Tobin-Richards *et al.*, 1983). These *indirect* effects of puberty (Petersen, 1987; Petersen and Taylor, 1980) have enabled us to begin to understand the societal significance attached to pubertal change through the social construction of adolescent experience, such as grade-based expectations (Petersen, 1987; Petersen *et al.*, 1983). When societal norms are violated, as with adolescents who mature very early or very late, the PDS has enabled us to examine the psychological effects that may result from atypical pubertal status (Crockett and Petersen, 1987) or from deviant pubertal timing (Petersen and Crockett, 1985). Many studies of pubertal adolescents do not measure pubertal status and therefore are unable to assess the contributions of biosocial status to psychological growth and development.

The PDS is not recommended for studies of short-term changes over a few weeks or months, for example, in investigations of constructs such as mood or cognitive variation. In these cases, the PDS is unlikely to be sufficiently sensitive to short-term variations, because the response categories are imprecise and relative. For such investigations, more precise measurement of hormone changes would be essential.

Until more information is available concerning relative reliability and validity of the various measures, an investigator would be well advised to use all measures of pubertal change that are appropriate and feasible. The recent interest among researchers in pubertal effects will likely produce more information in the near future.

Clinical use of the PDS, for evaluation of an individual's pubertal status, would not be sensible. If actual clinical examination is not appropriate,

use of the picture or drawing versions of the SMS (e.g., Duke *et al.*, 1980; Morris and Udry, 1980) is recommended.

This examination of our measues of pubertal status demonstrates that it can be measured through a self-report method. Young adolescents are able to make appropriate distinctions about the changes occurring in their bodies. Not only do they report these changes in the expected sequence, but the timing of the changes is generally similar to those found in other growth studies. We have found in our longitudinal study that many young adolescents have some difficulty articulating their feelings about pubertal change and the personal meanings that these changes may hold for them. This serves to underscore the importance of a measure such as the PDS, in order to help us examine the indirect effects of pubertal status on adolescents and their behavior.

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