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The MMPI-ARC and MMPI-AF Scales: Psychometric Properties of the MMPI-2-RF's Restructured Clinical (RC) and Higher Order Factor Scales When Adapted for Use with Archival Adolescent MMPI Data

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Abstract

Objective: To explore the psychometric properties of MMPI-adapted versions of the MMPI-2-RF's RC and factor scales when applied to archival adolescent MMPI data. Method: We explored the internal consistency, temporal stability, and convergent and criterion validity of newly derived MMPI-adapted RC scales and MMPI-adapted higher-order factors (MMPI-ARC and MMPI-AF) using data from the first normative adolescent MMPI samples: 3,971 ninth graders assessed in Minneapolis public schools in 1947-1948 and 11,329 ninth graders assessed statewide in 1954. Results: Most MMPI-ARC and MMPI-AF scales showed good internal reliability. Scale reliability did not vary uniformly with the proportion of items available in the original MMPI. The MMPI-ARC scales corresponded most strongly with the same-numbered original MMPI scales 1, 7, 8 and 9, and least with scale 3. ARC4 and ABXD were strong predictors of behavior, and ARC3 and 4 captured much of the covariation of reported problem behaviors with MMPI CYN and MMPI Scale 4, respectively. Conclusions: This first psychometric investigation of the MMPI-ARC and MMPI-AF scales suggests that they represent additional, powerful research tools for studies based on historically invaluable, MMPI-assessed samples.

Introduction

Few, if any, psychological assessment instruments have seen the worldwide research, clinical, and general uses of the Minnesota Multiphasic Personality Inventory (MMPI; Hathaway & McKinley, 1943) and its successors, the Minnesota Multiphasic Personality Inventory-2 (MMPI-2; Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989), the Minnesota Multiphasic Personality Inventory-Adolescent (MMPI-A; Butcher, Williams, Graham, Archer, Tellegen, Ben-Porath, & Kaemmer, 1992), and the Minnesota Multiphasic Personality Inventory-2 Restructured Form (MMPI-2-RF; Tellegen & Ben-Porath, 2008; Ben-Porath & Tellegen, 2008). In the decades since the original MMPI scales were formulated, genetic, neurophysiological, clinical, and personality research have revealed more clearly the underlying dimensional structures of personality and psychopathology vulnerability. The MMPI-2-RF reflects many of these advances and began with Tellegen, Ben-Porath, McNulty, Arbisi, Graham, and Kaemmer's (2003) initial Restructured Clinical (RC) Scales. The RC scales are not mere recapitulations of the original MMPI or MMPI-2 scales, but instead, extract "distinctive core features of each, after removing Demoralization variance" (Tellegen et al., 2003, p.1), which,

shared among the original scales, had reduced their discriminant validity. The RC scales opened a new chapter in MMPI assessment and attracted considerable interest, including an entire issue of *Personality Assessment* (Archer, 2006; Caldwell, 2006; Meyer, 2006). The MMPI-2-RF's RC scales and three second-order factors of Emotional Internalizing Dysfunction (EID), Behavioral Externalizing Dysfunction (BXD), and Thought Dysfunction (THD) represent useful assessment tools, which also may expand the research potential of archival MMPI samples, including various medical, military, forensic, school, and community samples, as well as some archival adoption and twin studies. The original MMPI was so widely translated for other languages and cultures that, worldwide, archival and longitudinal follow-up studies may be enhanced through the newer MMPI-2-RF scales adapted to archival MMPI items.

The MMPI-2-RF scales, based in the MMPI-2 item pool, contain some items that post-date the original MMPI, which leads to varying degrees of scale attenuation, a potential limitation for archival data sets, and yet, the RC scales seem robust even in MMPI-2 samples for which up to 50% of responses were unscorable (Dragon, Ben-Porath, & Handel, 2012). This suggests more than sufficient robustness of the RC scales for use with the original MMPI item pool, which contains at least 72.7% of MMPI-2-RF scale items (ARC-4) and up to 96.4% (ARC9). Furthermore, despite the MMPI-2's minor rewording of 87 original MMPI items to make them simpler, clearer, and more appropriate to contemporary culture (Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989), these changes produced no reductions in item-to-scale correlation (Ben-Porath & Butcher, 1989). The vast majority of MMPI items critical to the MMPI-2-RF scales have remained unchanged (Ben-Porath & Tellegen, 2008; Tellegen & Ben-Porath, 2008).

The RC scales already have shown promise when adapted to the original MMPI item pool, contributing to the discriminant prediction of adult antisocial personality and schizophrenia from adolescent samples (Bolinskey, Trumbetta, Hanson, & Gottesman, 2010). The potential utility for other archival follow-up studies of the MMPI-adapted RC and factor scales (henceforth called MMPI-ARC and MMPI-AF or ARC and AF scales) led us to conduct this first systematic investigation of the adapted scales' psychometric properties, specifically examining the internal and temporal consistency and the convergent and criterion validity.

Method

Participants

Hathaway and Monachesi (1963) described their citywide and statewide MMPI samples of ninth graders, respectively, assessed through Minneapolis public schools in 1947-1948 and Minnesota public and parochial schools in 1954. Most participants provided follow-up information in early adulthood. The current citywide sample is described in a previous study (Trumbetta, Seltzer, Gottesman, & McIntyre, 2010) in which profiles were eliminated as invalid if omitted or "cannot say" items>35 (hereafter referred to as *?*-invalid) or if Raw F>25 or if participant age fell outside the normative range of 13 to 16 years old at first assessment. We used the same exclusion criteria for the statewide sample. Primarily northern European, the two samples' representations of Native American and/or African American ancestry were estimated at 0.4% and 0.5%, respectively, from 1950 Minnesota census data (M. McMurry, Minnesota State Demographic Center, personal communication, 20 April 2009).

Citywide Minneapolis (1947) sample. Of Hathaway and Monachesi's (1963) reported 3971 citywide ninth graders (1958 males, 2013 females), their electronic archive contained 3872 cases (1903 males, 1969 females). After comparison with hard-copy records and exclusions for

age and invalidity, the citywide Minneapolis sample yielded 1812 male and 1889 female valid cases.

Statewide Minnesota (1954) sample. From 11,338 student names (5,707 male, 5,631 female) in the original statewide lists, Hathaway and Monachesi (1963) reported a total of 5701 males and 5628 females in this statewide sample, or 11,329 cases, 11,322 of which (5695 males and 5627 females) had sufficient data for a study of urban-rural differences in adolescent personality (Hathaway, Monachesi, and Young, 1959). The electronic archive of MMPI data, however, recorded only 11,216 cases, 5630 male and 5586 female. After comparison with hard-copy records and exclusions for age and invalidity, the statewide sample yielded 10,627 cases (5261 male and 5366 female). In the statewide subsample with valid twelfth grade MMPIs, 1738 males and 1806 females also had valid ninth grade MMPIs, yielding 3544 valid cases for test-retest comparison.

Measures

MMPI scoring. We converted MMPI-2 item numbers from RC, EID, BXD, and THD to those used in the original MMPI Group Form to create the MMPI-ARC and -AF scales, archival estimates of the MMPI-2-RF's RC scales and higher-order factors. Whenever an item was repeated in the original MMPI, we used only the item's first appearance in computing an ARC or AF scale. In the absence of adolescent norms for the MMPI-ARC and AF scales, we used raw scores and, for comparison, retained raw scores for all other MMPI measures. Electronic re-computation from MMPI items of scales' raw scores improved reliability over Hathaway's original hand-scoring.

Other variables. We utilized archival data on delinquency, teacher-rated conduct and adjustment problems, and high school drop-out to examine their relative associations with the MMPI, MMPI-ARC, and MMPI-AF scales. Severity-coded on a scale of 1-4, delinquency ranged from minor offenses to felonies, with 0 added to represent non-delinquent cases. Ascertained once in the statewide sample and twice in the citywide sample, delinquency scores for citywide participants could be up to twice that for statewide participants. The statewide archive (but not the citywide archive) contained teacher and school personnel ratings of adjustment problems (such as excessive fearfulness, petulance, or other indicators of dysfunction) and conduct problems, respectively, each on a 0 to 4 scale, with 0 for no problems, 1 for minor problems, 2 to 3 for increasingly severe problems, and 4 for problems requiring intervention from professional services or legal authorities beyond the school.

Analyses

Internal and temporal reliability. We computed Cronbach's alpha and plotted it by MMPI-available RC and higher-order factor items for each scale to examine the internal reliability of the ARC and AF scales according to their degree of attenuation. We also assessed the scales' temporal stability between ninth and twelfth grade, first with the Pearson correlation (*r*), and then, after correcting for internal unreliability (stability *r* / internal consistency estimate).

Convergent validity. We examined correlations of the ARC and AF scales with the original MMPI Wiggins Content scales and Harris-Lingoes subscales to see which older constructs were most strongly associated with each of them. As the RC scales were designed to create distinct constructs, implicitly reducing scale overlap, we also compared the inter-correlations of the MMPI-ARC scales with those of the original MMPI's clinical scales.

We evaluated the predictive validity of the ARC and AF scales by computing direct correlations with behavioral measures, specifically adolescent delinquency, conduct problems, adjustment problems, and high school graduation. We did the same with the original MMPI scales, and then compared these MMPI-behavior correlations with their partial correlations after removing MMPI-ARC scale-related covariation. Theoretically, if an ARC scale completely accounts for the corresponding MMPI numbered scale's covariance with a behavior, then the partial correlation of the original MMPI scale with that behavior would drop to zero after accounting for the MMPI-ARC scale. Lower partial correlations would indicate scales in which ARC component closely mirrored the predictive content of the original scale. Higher partial correlations would indicate scales that did not fully capture the original scale's covariance with the behavior, and would be expected wherever a new scale, for improved discriminant validity, has focused on a distinctive component from the more heterogeneous original scale. Original scale heterogeneity stemmed both from unidentified Demoralization variance and from the inclusion of multiple symptom dimensions (as seen clearly in original scales 2 and 8), as well as from nonspecific items (such as "I forget right away what people say to me" from original scale 7), which could represent any number of conditions, and yet, still predict the same behavioral outcome. As RC3 (Cynicism) represents a different construct from MMPI scale3 (Hysteria), we also computed direct and partial correlations of the behavioral measures with the MMPI-2 Cynicism content scale using the MMPI's available 21 of 23 MMPI-2 items in the scale.

Results

Composition and internal and temporal reliability of MMPI-adapted MMPI-ARC scales

The proportions of RC scale items available in the original MMPI Group Form were 79.2% for Demoralization (RCd; 19/24 items), 96.3% for Somatic Complaints (RC1; 26/27), 82.4% for Low Positive Emotions (RC2; 14/17), 80.0% for Cynicism (RC3; 12/15), 72.7% for Antisocial Behavior (RC4; 16/22), 88.2% for Ideas of Persecution (RC6; 15/17), 87.5% for Dysfunctional Negative Emotion (RC7; 21/24), 88.9% for Aberrant Experiences (RC8; 16/18), and 96.4% for Hypomanic Activation (RC9; 27/28). For factor scales, the proportions of items available were 87.8% for Emotional Internalizing Dysfunction (AEID; 36/41), 82.6% for Behavioral Externalizing Dysfunction (ABXD; 19/23), and 92.3% for Thought Dysfunction (ATHD; 24/26).

Statistically significant differences between citywide and statewide samples emerged for all MMPI-ARC and MMPI-–AF raw score means (Table 1), as expected, given the large *n* of each sample. Rural-urban differences probably contributed to these findings (Gottesman et al., 1987). Sex differences were found for all of the MMPI–AF raw score means ($p<.001$ state and city), except for Thought Dysfunction (ATHD, $p=.74$; city), with effect sizes ranging from Cohen's $d=.01$ and .13 for Thought Dysfunction in city and state, respectively, to $d=.23$ and .20 for Emotional Internalizing Dysfunction, to $d=.86$ and .82 for Behavioral Externalizing Dysfunction. Most MMPI-ARC raw score means also showed significant sex differences within sample, with smaller effects seen for Demoralization (ARCd, Cohen's $d=.10$ and .03, city, $p=.002$; state, $p<.001$), Somatic Complaints (ARC1, $d=.14$, $p=.004$; state only), Ideas of Persecution (ARC6; $d=.17$, $p<.001$, state only), and Aberrant Experiences (ARC8; $d=.07$, $p=.01$, state only). Sex differences were larger for Cynicism (ARC3; $d=.33$ and .38), Hypomanic Activation (ARC9; $d=.34$ and .31), Dysfunctional Negative Emotion (ARC7; $d=.40$ and .32), and Antisocial Behavior (ARC4; $d=.56$ and .53), all significant at $p<.001$. Only Low Positive

Emotions *(*ARC2; state, p=.90; city, p=.34) showed no significant sex differences in either sample.

Table 1. MMPI-ARC scales' raw score means and standard deviations by sample and sex

Citywide Minneapolis Sample

	All (*n*=3701)	Male (*n*=1812)	Female (*n*=1889)
*ARC*d	4.61 (3.42)	4.43 (3.25)	4.78 (3.56)
*ARC*1	3.34 (2.84)	3.33 (2.75)	3.35 (2.93)
*ARC*2	3.38 (1.82)	3.41 (1.83)	3.36 (1.81)
*ARC*3	6.28 (2.80)	6.74 (2.69)	5.84 (2.82)
*ARC*4	3.46 (2.63)	4.20 (2.81)	2.74 (2.22)
*ARC*6	1.64 (1.78)	1.66 (1.79)	1.62 (1.77)
*ARC*7	7.73 (4.39)	6.86 (4.20)	8.56 (4.41)
*ARC*8	2.82 (2.49)	2.83 (2.49)	2.82 (2.49)
*ARC*9	12.96 (4.85)	13.78 (4.91)	12.17 (4.66)
EID	10.12 (5.12)	9.51 (4.84)	10.70 (5.31)
BXD	5.77 (3.47)	7.17 (3.54)	4.43 (2.81)
THD	3.08 (2.63)	3.09 (2.62)	3.06 (2.63)

Statewide Minnesota

	All (*n*=10,627)	Male (*n*=5261)	Female (*n*=5366)
*ARC*d	5.00 (3.58)	4.85 (3.44)	5.15 (3.71)
*ARC*1	3.63 (3.04)	3.55 (2.94)	3.72 (3.12)
*ARC*2	3.59 (1.91)	3.59 (1.89)	3.58 (1.92)
*ARC*3	5.76 (2.85)	6.30 (2.76)	5.24 (2.83)
*ARC*4	3.35 (2.51)	3.98 (2.68)	2.74 (2.16)
*ARC*6	1.96 (2.01)	2.11 (2.07)	1.81 (1.95)
*ARC*7	8.03 (4.37)	7.32 (4.25)	8.73 (4.37)
*ARC*8	.22 (2.65)	3.28 (2.66)	3.15 (2.64)
*ARC*9	12.67 (4.85)	13.41 (4.92)	11.94 (4.67)
AEID	10.75 (5.27)	10.20 (4.98)	11.29 (5.49)
ABXD	.56 (3.34)	6.82 (3.41)	4.32 (2.76)
ATHD	3.58 (2.89)	3.73 (2.94)	3.42 (2.83)

The two samples produced very similar estimates of internal consistency for the MMPI-ARC and -AF scales (Table 2). Factor scales' internal consistency all averaged over .70 across the combined city and state samples, with AEID highest and ATHD lowest. Cronbach's alpha for ARC scales ranged from .49 to .81, with the highest estimates ($\geq$.70) for Dysfunctional Negative Emotion *(*ARC7), Demoralization *(*ARCd), Hypomanic

Activation *(*ARC9), Cynicism *(*ARC3), and Aberrant Experiences *(*ARC8). Somatic Complaints *(*ARC1), Antisocial Behavior *(*ARC4), and Ideas of Persecution *(*ARC6) showed slightly less internal consistency, with alphas well above 0.60. Low Positive Emotions *(*ARC2) showed the least internal consistency, roughly 0.50.

Table 2

MMPI-ARC *Scales' Internal Consistency by Sample*

	Cronbach's alpha	
	City	State
ARCd	0.74	0.75
ARC1	0.59	0.64
ARC2	0.43	0.45
ARC3	0.73	0.72
ARC4	0.67	0.64
ARC6	0.63	0.67
ARC7	0.81	0.79
ARC8	0.70	0.70
ARC9	0.77	0.76
AEID	0.79	0.79
ABXD	0.76	0.73
ATHD	0.69	0.71

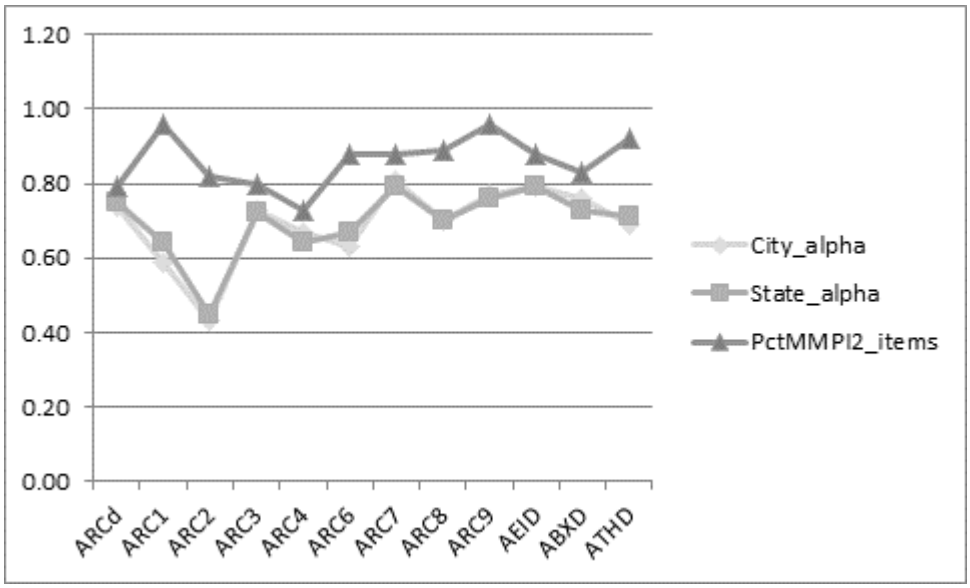

Figure 1. Internal consistency as a function of the proportion of original RC and factor items included in the MMPI-ARC and –AF scales: Alpha and percentage of MMPI-available items by scale.

Figure 1 plots internal consistency according to the percentage of RC items available for the MMPI-ARC and –AF scales. Reliability generally follows item coverage with a few notable exceptions. The MMPI-adapted Low Positive Emotions *(*ARC2) contains 83.4% of the scale's items, and yet, its internal consistency is only around 0.45, while Cynicism *(*ARC3), with a comparable 80% of items, produces a Cronbach's alpha over .70. Antisocial Behavior shows the lowest percentage (72.7%) of items, but shows internal consistency in the 0.64-0.67 range, lower than most scales but higher than Low Positive Emotions.

Table 3

MMPI-ARC and AF scales' temporal stability between ninth and twelfth grade administrations for statewide sample and by sex, with comparison to Hathaway and Monachesi's (1963) report for the original MMPI scales (based on fewer excluded participants).

	State sample all		State sample males		State sample females	
	ARC(r)	Reliability-	*ARC (r)*	*MMPI (r)*	*ARC(r)*	*MMPI (r)*
(n)	(3544)	corrected	(1738)	(1922)	(1806)	(2054)
ARCd	0.51	.68	0.48	---	0.55	---
ARC1	0.43	.67	0.36	0.34	0.49	0.41
ARC2	0.39	.87	0.34	0.38	0.43	0.47
ARC3	0.51	.71	0.47	0.37	0.52	0.44
ARC4	0.55	.86	0.53	0.36	0.51	0.38
ARC6	0.42	.63	0.40	0.32	0.43	0.36
ARC7	0.56	.71	0.53	0.37	0.57	0.50
ARC8	0.49	.70	0.44	0.37	0.54	0.52
ARC9	0.56	.74	0.53	0.47	0.56	0.45
EID	0.57	.72	0.53	---	0.59	---
BXD	0.61	.84	0.53	---	0.55	---
THD	0.48	.68	0.44	---	0.52	---

Temporal stability (Pearson's *r*), based on valid responses at ninth and twelfth grades from the full retested twelfth grade statewide subsample, ranged from 0.39 to 0.61 and, when corrected for internal consistency, from .63 to .87. With the exception of ARC2, the numbered scales showed equal or better stability than the original MMPI same-numbered scales (Hathaway & Monachesi, 1963). This is consistent with the removal of demoralization variance, which often contains more state-related variance than does the underlying personality structure.

Inter-correlations among MMPI-ARC scales were similar across sex and sample and seemed to meet one goal of the RC scales, to increase discriminant validity. (Complete tables are available upon request from authors.) The MMPI-ARC scales 1, 2, 4, and 7-9 generally showed lower inter-correlations than their counterpart MMPI scales. On the other hand, higher inter-correlations were observed for ARC3, which showed significant correlations with ARC9 (*r*=.48 to .53 across sex and sample, versus *r*=-0.16 to .004 for MMPI scales 3 and 9) and ARC4

(*r*=.33 to .36 across sex and sample, versus *r*=.21 to .32 for MMPI scales 3 and4), reflective of the RC3's focus on the construct of cynicism (Ben-Porath & Tellegen, 2008; Tellegen & Ben-Porath, 2008). Tellegen et al.'s (2003) unique Demoralization scale, transposed to the MMPI as ARCd, showed moderately high correlations with most other scales, from Dysfunctional Negative Emotions *(*ARC7) with the highest correlation (*r*=.68 to .71 across sex and sample) to Low Positive Emotions *(*ARC2) with the lowest (*r*=.28 to .40 across sex and sample). As traditionally observed in the negative association between MMPI scales 2 and 9, and as might be expected from positive emotions associated with hypomania, low positive emotions *(*ARC2) showed a modest negative association with Hypomanic Activation *(*ARC9) for both samples (*r*=-0.05 to -0.12 across sex and sample).

Convergent and criterion validity: Comparisons to other MMPI *measures*

Table 4 uses a pattern of underlined and boldfaced type to identify the strongest associations between specific MMPI-ARC and MMPI scales. In each column, the two underlined correlations represent the two MMPI scales most strongly associated with each MMPI-ARC scale, respectively. Across each row, the two boldfaced correlations represent the two MMPI-ARC scales with the strongest associations with each respective MMPI scale. If the MMPI-ARC scales represent the core constructs of the original MMPI scales, then one would expect to see a perfect diagonal of underlined, boldfaced correlations across the city and state samples for scales 1-9.

This is true for all scales but MMPI-ARC3. Hysteria (MMPI scale 3) consistently shows one of its highest magnitude correlations (but in a negative direction) with Tellegen et al.'s (2003) Cynicism, and yet, Cynicism is more strongly associated with original MMPI scales 7 and 8 than with 3. However, MMPI-ARC3 shows a stronger association with the MMPI-2 content scale, Cynicism, with $r = 0.89$ and 0.88 for citywide and statewide, respectively. Two MMPI-ARC3 items were not found in the Cynicism content scale and nine MMPI items in the Cynicism scale did not appear in the MMPI-ARC3.

Most of the correlations of the MMPI-ARC scales with original MMPI scales were significant at $p<.005$ or less, given the large *n* of each sample. This also was true of the MMPI subscales and Wiggins content scales (full tables available upon request). The Demoralization (ARCd) scale's strong associations (>.70) with Brooding, subjective Depression, Mental Dullness and Lack of Ego Mastery-Conative and its moderate to small associations (<.70 and >.20) with all other MMPI subscales (except for psychomotor retardation and authority problems) suggest that, even with its necessary attenuation, the ARCd scale captures the kind of nonspecific and subjective distress common to various forms of psychopathology. Its strongest correlations with Wiggins scales were with Depression and Poor Morale.

The construct validity of the Somatic Complaints *(*ARC1) scale was supported by its high correlation with the Harris Lingoes subscale of the same name (Hy4; *r*=.85 for both city and state) and its secondary correlation with Bizarre Sensory Experiences (Sc3; *r*=.67 city, .69 state), as well as by its high correlations with the Wiggins scales Organic Problems (*r*=.84 city, .85 state) and Health concerns (*r*=.71 city, .72 state). The Low Positive Emotions *(*ARC2) scale was associated with Subjective Depression (D1; *r*=.58 city, .61 state) and Mental Dullness (D4; *r*=.50 city, .52 state) and with Wiggins' Social maladjustment scale (*r*=.48 city, .46 state), slightly more than with Wiggins' Organic Problems (*r*=.32 city, .34 state) or Depression (*r*=.30 city, .34 state) scales.

Table 4

Correlations of MMPI-ARC *scale raw scores with corresponding raw scores for original MMPI primary scales by sample*

	ARCd	ARC1	ARC2	ARC3	ARC4	ARC6	ARC7	ARC8	ARC9
Minneapolis sample (n=3701)									
raw1	**0.51**	**0.88**	0.35	0.22	0.37	0.38	0.37	0.42	0.26
raw2	**0.37**	**0.37**	**0.54**	-0.04	0.06	0.15	0.1	0.05	-0.22
raw3	0.04	**0.44**	0.25	**-0.38**	0.00	0.00	-0.15	-0.02	-0.26
raw4	**0.54**	0.39	0.25	0.28	**0.66**	**0.54**	0.30	0.40	0.33
raw6	**0.45**	0.40	0.27	-0.10	0.34	**0.64**	0.31	0.40	0.23
raw7	**0.84**	0.51	0.31	0.44	0.43	0.56	**0.83**	0.64	0.56
raw8	**0.79**	0.60	0.29	0.48	0.59	0.69	0.70	**0.76**	0.61
raw9	0.44	0.31	-0.12	0.45	0.52	0.50	0.42	**0.56**	**0.72**
Minnesota sample (n=10,627)									
raw1	**0.52**	**0.89**	0.37	0.23	0.37	0.42	0.41	0.46	0.24
raw2	**0.41**	0.40	**0.57**	-0.01	0.13	0.20	0.17	0.14	-0.21
raw3	0.08	**0.45**	0.30	**-0.36**	0.05	0.001	-0.10	0.01	-0.24
raw4	**0.54**	0.37	0.31	0.27	**0.64**	0.52	0.32	0.37	0.28
raw6	**0.48**	0.44	0.30	-0.03	0.38	**0.66**	0.35	0.4	0.25
raw7	**0.85**	0.54	0.31	0.45	0.43	0.59	**0.83**	0.67	0.56
raw8	**0.78**	0.62	0.31	0.49	0.57	0.70	0.70	**0.77**	0.58
raw9	0.45	0.32	-0.10	0.45	0.50	0.51	0.44	**0.57**	**0.72**

Note: Underline indicates the two MMPI constructs most strongly associated with each MMPI-ARC scale, or which constructs each MMPI-ARC scale best captures. (Columns)
Bold font indicates the two MMPI-ARC scales most strongly associated with each MMPI clinical scale, or which MMPI-ARC scales best capture each original MMPI construct. (**Rows.)**

The Cynicism *(*ARC3) scale scored in the opposite direction of the original MMPI scale 3 (*r*= -.38 city, -.36 state), showing strong negative associations with Naïveté (Pa3; *r*=-.82 both samples) and Need for Affection (Hy2; *r*= -.72 both) and positive associations with Wiggins' Authority Problems (*r*=.85 both), and Hostility (*r*=.59 city, .58 state). The Antisocial Behavior *(*ARC4) scale correlated, as expected, with Psychopathic Deviate subscales Familial Discord (Pd1; *r*=.60 city, .59 state) and Authority Problems (Pd2; *r*=.60 city, .57 state) and with Wiggins' Authority Problems (*r*=.54 city, .52 state) and Family Conflict (*r*=.60 city, .59 state) as well as with Schizophrenia (Sc1a) subscale Social Alienation (*r*=.52 city, .51 state).

The Ideas of Persecution *(*ARC6) scale was most strongly correlated with Paranoia's Persecutory ideas subscale (Pa1; *r*=.90 city, .91 state) and with the Social Alienation subscales of scales 4 and 8, respectively (Pd4a; *r*=.65, both and Sc1a; *r*=.66 city, .68 state), as well as with Wiggins' scales of Psychoticism (*r*=.76 city, .78 state) and Depression (*r*=.59 city, .60 state). The Dysfunctional Negative Emotionality *(*ARC7) scale showed strongest associations with

subscales of original MMPI scales 2 and 8, Brooding (D5; *r*=.60 city, .61 state) and Lack of Ego Mastery, Defective Inhibition (Sc2c; *r*=.69 city, .70 state), as well as with Wiggins' Poor Morale (*r*=.81 both) and Depression (*r*=.77 city, .76 state). The Aberrant Perceptual Experiences *(*ARC8) scale correlated most strongly with Bizarre Sensory Experiences (Sc3; *r*=.83 city, .84 state), and with two Lack of Ego Mastery subscales, Cognitive (Sc2a; *r*=.84 city, .83 state) and Defective Inhibition (Sc2c; *r*=.67city and .69 state) as well as with Wiggins' Psychoticism (*r*=.82 city, .83 state) and Depression (*r*=.61 city, .62 state). The Hypomanic Activation *(*ARC9) scale correlated most strongly with the Hypomania subscales Psychomotor acceleration (Ma2; *r*=.68 both) and Ego Inflation (Ma4; *r*=.63 city, .64 state), as well as with Wiggins' Hostility (*r*=. =.80 city, .79 state) and Hypomania (*r*=. =.78 city, .77 state).

At the level of the higher-order factors, Emotional Internalizing Dysfunction (AEID) was most strongly associated with Wiggins Depression (*r*=.83 city, .84 state), and next with Wiggins Poor Morale (*r*=.79 both), Welsh A (*r*=.79 both), MMPI Psychasthenia (scale 7; *r*=.82, city; .56 state) and Schizophrenia (scale 8; *r*=.73 city, .49 state), as well as with Harris Lingoes Subjective Depression (D1; *r*=.76 city, .78 state) and Brooding (D5; *r*=.73 city, .74 state). The Thought Dysfunction (ATHD) factor showed its strongest associations with Wiggins Psychoticism (*r*=.85 city; .87 state) and Schizophrenia (scale 8; *r*=.76 city, .65 state) and with Harris Lingoes Bizarre Sensory Experiences (Sc3; *r*=.73 city, .76 state) and Persecutory ideas (Pa1; *r*=.74 city, .78 state). The Behavioral Externalizing Dysfunction (ABXD) factor was less strongly associated with previous scales than were the other factors, showing its strongest correlations with Wiggins Hostility (*r*=.66 city, .65 state) and Authority Conflicts (*r*=.65 city, .64 state), MMPI Hypomania (scale 9, *r*=.62 city, .57 state) and Harris Lingoes Psychomotor acceleration (Ma2; *r*=.53 city, .51state), Authority Problems (Pd2; *r*=.52 city, .49 state), and Amorality (Ma1; *r*=.52 city, .49 state).

Table 5

Pearson's correlation (r) of ARC and AF scales with behavioral measures

	Delinquency		HS Graduation		Conduct	Adjustment
Scale	City	State	City	State	State only	State only
ARCd	.09	.49	-.15	-.10	.05	.08
ARC1	.08	.002	-.17	-.11	.06	.07
ARC2	.03	.05	-.09	-.10	.05	.08
ARC3	.17	.09	-.15	-.09	.06	.09
ARC4	.37	.29	-.32	-.28	.24	.26
ARC6	.14	.10	-.15	-.14	.09	.11
ARC7	-.003	-.03	-.07	-.04	-.002	-.003
ARC8	.08	.03	-.13	-.09	.04	.06
ARC9	.16	.11	-.10	-.07	.09	.08
AEID	.05	.02	-.13	-.10	.04	.06
ABXD	.35	.28	-.24	-.20	.22	.23
ATHD	.10	.06	-.15	-.12	.06	.09

MMPI-ARC *and –AF scales prediction of real-world behavioral measures.* Table 5 presents correlations of MMPI-ARC and -A*F* scales with later outcomes of delinquency, high school graduation/dropout, and teacher ratings of conduct and adjustment problems, while Table 6 presents correlations of these behaviors with the original MMPI as well as the partial correlations between MMPI scales and behavior after removing variance explained by the MMPI-ARC scales. As Tables 5 and 6 show, the MMPI-ARC and original MMPI scales to which they correspond are consistent with in their prediction of behavioral outcomes, with scale 4 in both cases accounting for much of the behavioral variance, and ABXD and ARC4 generally out-performing the original MMPI scale 4.

Table 6

Items in MMPI full and MMPI-ARC scales, correlations of behavioral measures with original MMPI scales raw scores and partial correlations after controlling for corresponding MMPI-ARC scales and MMPI-2 Cynicism Content Scale

				Delinquency				High School Graduation			
	n items			City		State		City		State	
	RC	ARC	%	*r*	*pr*	*r*	*pr*	*r*	*pr*	*r*	*pr*
raw1	33	26	78.7	.09	.07	.03	.01	-.16	-.02	-.13	-.03
raw2	60	14	23.3	-.02	-.04	-.02	-.05	-.09	-.05	-.10	-.06
raw3	60	12	20.0	-.01	.06	-.04	.01	-.05	-.11	-.05	-.10
raw4	50	16	32.0	.28	.04	.22	-.003	-.27	-.08	-.21	-.02
raw6	40	15	37.5	.11	.03	.09	.02	-.15	-.01	-.12	-.04
raw7	48	21	43.8	.06	.10	.03	.08	-.12	-.12	-.10	-.12
raw8	78	16	20.5	.16	.14	.11	.12	-.19	-.14	-.16	-.13
raw9	46	27	58.7	.20	.13	.16	.08	-.13	-.08	-.12	-.09
CYN (with ARC3)			---	.14	-.03	.11	.004	-.14	-.02	-.10	-.007

				Conduct State only		Adjustment State only	
	RC	*ARC*	*%*	*r*	*pr*	*r*	*pr*
raw1	33	26	78.7	-.16	-.02	-.13	-.03
raw2	60	14	23.3	-.09	-.05	-.10	-.06
raw3	60	12	20.0	-.05	-.11	-.05	-.10
raw4	50	16	32.0	-.27	-.08	-.21	-.02
raw6	40	15	37.5	-.15	-.01	-.12	-.04
raw7	48	21	43.8	-.12	-.12	-.10	-.12
raw8	78	16	20.5	-.19	-.14	-.16	-.13
raw9	46	27	58.7	-.13	-.08	-.12	-.09
CYN (with ARC3)			---	-.14	-.02	-.10	-.007

Table 6 reveals that little covariance remains between the original MMPI scales 4, 6, and 9 and all of these behavioral outcomes (cf. Wirt & Briggs, 1959) after accounting for scales ARC4, 6, and 9, respectively. Similarly, ARC3 accounts for much of the covariance between these behavioral outcomes and Cynicism.

Discussion

The MMPI-ARC and MMPI-AF scales represent an adaptation of MMPI-2 RC/MMPI-2-RF scales to items available in the original MMPI group form. The adaptation of contemporary RC scales to the older cohorts and adolescent populations of Hathaway and Monachesi's samples, as well as to the older wording of some items in the original MMPI, may account for any decrements in the reliability or validity of the MMPI-ARC and MMPI-AF relative to the RC and MMPI-2-RF factor scales. Nonetheless, most of the MMPI-ARC scales showed good to excellent internal consistency when adapted to the MMPI using raw scores and, specifically, for these adolescent cohorts. The temporal reliability of the MMPI-ARC scales generally met or exceeded that of the original MMPI scales and was also comparable to rank-order correlations for personality traits among contemporary adolescents (Klimstra, Hale, Raaijmakers, Branje, & Meeus, 2009), demonstrating significant stability of measurement amid the fluidity of adolescent personality (Caspi, Roberts, & Shiner, 2005) and of the nonlinear adolescent brain development that may underlie that fluidity (Casey, Getz, & Galvan, 2008). The MMPI-ARC scales performed very similarly across these two adolescent samples, one primarily from post-World War II urban areas in the 1940's and the other from a range of urban to rural areas in the 1950's.

Low positive emotionality underperformed the other MMPI-ARC scales, and may require further investigation for use with MMPI archival samples. By contrast, ARC4 had particularly strong temporal and internal reliability, despite truncation. In its ability to account for the MMPI scale 4's prediction of conduct and adjustment problems in school, high school graduation, and delinquency, the ARC4 seems to have captured a core component with better psychometric properties than the original scale 4, and ABDX showed similar promise as a predictor of problem behavior. The evidence also suggests that ARC3 captures a core component of the Cynicism construct.

Since their creation of the RC scales, Tellegen and Ben-Porath's (2008) MMPI-2-RF has added numerous validity scales as well as specific problem scales, all worthy of investigation for their applicability to archival MMPI data. Overall, this preliminary examination of the MMPI-ARC and –AF scales demonstrates their general robustness despite any attenuation due to missing or reworded items. Even when applied retrospectively to much earlier cohorts of adolescents, the MMPI-ARC and –AF scales seem to stand the test of time, and for follow-up studies of MMPI-assessed samples, comprise a valuable research tool, giving new life to investigations of historically invaluable MMPI samples.

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