Assessing medication adherence self-efficacy among low-literacy patients: development of a pictographic visual analogue scale

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Abstract

Health behavior interventions are often grounded in Social Cognitive Theory, but instruments used to assess self-efficacy rely on verbal skills and yield scores that are highly positively skewed. Based on a review of the research literature and qualitative research with key informants, a pictographic medication adherence self-efficacy scale was developed. Two studies were conducted to test the pictographic and color visual analogue scale for assessing self-efficacy for medication adherence. Study 1 ($N = 81$) demonstrated that the pictographic self-efficacy scale was internally consistent ($\alpha = 0.68$), time stable (2-week test–re-test $r = 0.63$), and showed evidence for convergent and divergent construct validity. Study 2 ($N = 64$) further supported the reliability of the pictographic self-efficacy scale with additional data supporting its convergent, divergent and criterion-related validity, including associations with medication adherence and HIV viral load. Distributions of self-efficacy scores approximated normal. This newly developed pictographic scale may be useful in assessing medication adherence self-efficacy in lower-literacy populations.

Introduction

People living with HIV-AIDS who are receiving antiretroviral medications must strictly adhere to multi-drug regimens to achieve optimal treatment responses (Barlett, 2002). Similar to other complex health behaviors, successful medication adherence is associated with an individual’s confidence in their ability to take their medications as directed (Gifford \textit{et al.}, 1996; Catz \textit{et al.}, 2000). Self-efficacy is defined as the personal belief that one can successfully perform a specific action under specified conditions (Bandura, 1997). In the case of medication adherence, self-efficacy beliefs correlate with self-reported and objectively measured missed medication doses (Eldred \textit{et al.}, 1998; Demas \textit{et al.}, 1998; Misener and Sowell, 1998; Catz \textit{et al.}, 2000). Although self-efficacy may be useful in understanding and predicting health behaviors (Bandura, 1997), self-efficacy is often poorly assessed. In a review of 65 published studies that assessed self-efficacy for HIV risk reduction, for example, Forsyth and Carey (Forsyth and Carey, 1998) determined that self-efficacy scales are often conceptually flawed and lack construct validity; 45% of studies that purportedly measured self-efficacy actually assessed constructs other than self-efficacy.

Assessing self-efficacy in relation to specific situations requires construction of realistic and relevant scenarios. A limitation of self-efficacy scales that present individuals with scenarios of challenging situations, however, is that these instruments usually depend on reading comprehension and ability to follow the logical order of situations. Reading comprehension demands can be particularly...
problematic in assessing HIV treatment adherence self-efficacy because HIV is most prevalent among populations with disadvantaged educations. To meet the need for a reliable and valid measure of HIV treatment self-efficacy for people with challenged reading skills, we developed a pictographic assessment of medication adherence self-efficacy. Pictographs have become commonplace in health education and health care [e.g. (Mayeux et al., 1996; Houts et al., 1998, 2001)]. Jacobson et al. (Jacobson et al., 1999), for example, demonstrated that a one-page educational handout with pictographs and minimal text increased pneumococcal vaccination more than five-fold over a control information handout. Similar findings were reported by Jolly et al. (Jolly et al., 1993, 1995). We built on pictographs used to improve the accessibility of health education materials to develop an assessment of adherence self-efficacy.

In this research a color visual analogue scale was also developed to record self-efficacy responses. The visual analogue scale avoided relying on verbal anchors and provided a wide range of responses, reducing scale vulnerability to ceiling effects (Bandura, 1997). Visual analogue scales have been successfully developed for assessing a number of complex constructs including depression, anxiety, mood and pain (Cella and Perry, 1986; McCormack et al., 1988). Visual analogue scales offer psychometric advantages including sensitivity to change, semantic and pictographic rather than numerical anchoring, fine gradations between responses, and interval-level response data. We therefore performed a series of scale development activities which were followed by two studies that evaluated the psychometric properties of the new scale.

**Scale development**

Previous research has identified barriers to medication adherence among lower literacy adults living with HIV-AIDS. For example, Kalichman et al. (Kalichman et al., 1999) found that 60% of people with HIV and lower reading literacy had missed doses of their medications because they overslept, 55% missed doses because they were busy and 30% missed their medications because unexpected things came up. Social situations also commonly delay taking HIV medications because of concerns about inadvertent HIV status disclosure (Catz et al., 2000). In addition, alcohol intoxication is a common barrier to medication adherence, with 17% of people who drink heavily missing their medications over a week’s time (Cook et al., 2001). We therefore selected three situations for assessing medication adherence self-efficacy: becoming unexpectedly busy in a social situation, oversleeping and alcohol consumption.

To develop the scenarios for each of the three situations, we recruited 11 HIV-positive patients from area clinics to serve as key informants. These individuals were referred to the study by their case managers who were made aware of the opportunity to serve as key informants. HIV-positive men and women with less than 12 years of education, and who self-identified as having difficulty reading were asked about situations involving becoming unexpectedly busy, sleeping and alcohol use. Key informants were asked to generate stories from their own experience in which they had to remember to take their medications under the three conditions. We used participant descriptions of their own situations as the cornerstone for shaping the scenarios.

For each situation, a graduated scenario was also developed to allow self-efficacy assessments under increased situational demands (Maibach and Murphy, 1995; Bandura, 1997; Forsyth and Carey, 1998). Key informants were asked to describe their experiences related to the situations as well as what would make the situations more difficult. In the final step, the three sets of scenarios (two scenarios in each set, total six scenarios) were then presented to the key informants to provide feedback on the scenarios and to help refine their content. A second group of three male and two female key informants discussed and rated all of the scenarios for their realism and personal relevance. Responses were tabulated and comments were integrated for revising the final generation of scenarios.

After the final scenarios were established, each situation was illustrated in simple line-drawing
storyboards that coincided with a minimal situational description. A sketch artist was employed to generate the initial pictographic stimuli. We developed simple line drawings that depicted individuals who were of ambiguous ethnic backgrounds. In addition, we developed visual analogue scale response formats to remove verbal-dependent response categories and provide a wide range of responses.

Table I presents the three sets of final stimulus scenes used for assessing medication adherence self-efficacy. The instructions for responding to the scenarios were read aloud, stating that each scene depicted a person living with HIV who is taking anti-HIV medications. Participants were told that the person has been instructed by their doctor to take their medications exactly as directed. Then participants were told that they should imagine being the person in the situation and respond how confident they were that they could take their medications exactly as directed in that situation. Each scenario was presented twice, with the second presentation increasing the difficulty level, as suggested by Bandura (Bandura, 1997). Increased difficulty of the scenarios was ascertained from key informants (see above).

Following each scenario, participants were asked ‘How confident are you that you could take your medications in that situation as directed?’ and marked their level of confidence on a color visual analogue scale (see Figure 1).

Scores on the self-efficacy items were obtained by measuring the distance from left (Cannot do it at all) to right (Completely certain can do it) on each of the six visual analogue scales. Distance from the left edge to the respondent’s mark was measured in millimeters, yielding a range of possible scores between 0 and 255 mm for each response. Scores for the first gradation in each set were summed to obtain a subscore for the less challenging situation and scores for the second gradations were summed to provide a subscore for the more challenging situations (each subscore range 0–765 mm). A total score was obtained by summing the measurements across the six scenes (range 0–1530 mm) and divided by 6 to obtain a mean rating. The following two studies were conducted to examine the psychometric properties of the pictographic self-efficacy scale.

### Study 1: Preliminary reliability and validity

This study was conducted to provide an initial test of the reliability and construct validity of the

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**Table I. Scenarios presented with pictographs for assessing HIV treatment adherence self-efficacy**

<table>
<thead>
<tr>
<th>Scene 1: Unexpected visit</th>
<th>Scene 2: Oversleeping</th>
<th>Scene 3: Alcohol use</th>
</tr>
</thead>
<tbody>
<tr>
<td>You are coming home from shopping and run into an old (friend/lover). You haven’t seen him/her in a long time, so you decide to stop at his/her apartment for coffee. After a while you realize that you are having a good time talking to your (old friend/former lover). You do not have your evening medication dose with you and realize that you will have to go home right away in order to take the medication on time.</td>
<td>You have had difficulty sleeping for the last several nights. Last night you tossed and turned but finally fell asleep at 3 a.m. Your alarm rings at 7:30 a.m. to wake you up, but you are still really tired. You don’t need to be anywhere today, but you remember the alarm was set to remind you to take your medication. The medicine is (sitting on your bedside table with a glass of water ready for you/in the cabinet in your bathroom and you have to get out of bed to get it).</td>
<td>You are walking back from the bus stop and run into an old drinking buddy. He/She invites you to a bar for a drink. After a while, you have had (three/seven) beers and you’re having a good time talking with your old friend. (You are feeling quite intoxicated.) You do not have your evening medication dose with you and realize that you will have to go home right away in order to take your medications on time.</td>
</tr>
</tbody>
</table>

Language for gradations for increased task demands are shown in parentheses.
pictographic medication adherence self-efficacy scale. The study focused on examining distribution characteristics, internal consistency and test–re-test reliability of the scale as well as evidence for convergent and divergent validity.

Methods
Participants and procedures
Participants were 52 men and 29 women living with HIV-AIDS recruited from clinical and community support services in Atlanta, GA. All participants were currently receiving antiretroviral medications. In terms of race, all participants were African-American except for one man who was white. The mean number of years of education was 12.3 (SD = 2.4), mean number of years that participants had been diagnosed HIV-positive was 10.9 (SD = 5.7), 23% of participants had CD4 cell counts under 200 and 46% had been hospitalized at least once for an HIV-related condition. All measures were administered in face-to-face interviews. Participants attended a second assessment session 2 weeks later to be reassessed on the pictographic self-efficacy scale. All of the study procedures were approved by the University Institutional Review Board (IRB).

Measures
In addition to the pictographic self-efficacy scale, we administered a standard self-efficacy scale to assess convergent validity. To assess divergent validity we administered measures of self-efficacy for active engagement in medical care, self-efficacy for HIV disclosure decisions, self-efficacy for practicing safer sex and an AIDS-related knowledge test. Participants also completed measures of demographic characteristics, health history and current medication adherence.

Demographic characteristics, health history and medication adherence
Participants reported their gender, ethnicity, years of education and other common demographic characteristics. To assess medication adherence, participants reported their current medications and indicated whether they had missed any doses in the previous week. Responses were recorded Yes or No for having missed or not missed at least one dose of antiretroviral medications in the past week. Participants who missed at least one dose of their antiretrovirals were grouped for comparisons against those who did not miss a dose.

Standard medication adherence self-efficacy
For convergent validity, we assessed HIV treatment adherence self-efficacy using items adapted from a scale reported by Gifford et al. (Gifford et al., 1996). This scale was selected because it represents the type of instrument most commonly used to assess self-efficacy (Bandura, 1997). The six standard self-efficacy items assessed confidence in one’s ability to overcome barriers to treatment adherence and maintain close adherence to medications. Example items include ‘I am certain that I can take my HIV medications exactly as my doctor tells me to’, ‘I am certain that I can take my HIV medications on time even if I have to wake up from a deep sleep’ and ‘I am certain that I can take my HIV medications even if I have been drinking...’.
alcohol’. All items were responded to on scales ranging from 1, Strongly disagree, to 4, Strongly agree, $\alpha = 0.71$.

**Divergent self-efficacy**

Three self-efficacy scales were included to examine construct divergence from the pictographic treatment adherence self-efficacy scale. Three items were administered to assess self-efficacy for engaging in health care, e.g. ‘I am certain that I know when I need to call my doctor’ and ‘I am certain that I can understand what HIV is doing to my body’, $\alpha = 0.83$. Self-efficacy for HIV disclosure decisions was assessed with four items, e.g. ‘I am certain that I can discuss being HIV-positive with a new sex partner’ and ‘I am certain that I can decide about disclosing my HIV to a new sex partner even if I have been drinking’, $\alpha = 0.87$. Finally, self-efficacy for safer sex was assessed with five items that included ‘I am confident about suggesting using condoms with new sex partners’ and ‘I am confident that I can have safer sex and satisfy my partner’, $\alpha = 0.77$. All items were responded to 1, Strongly disagree, to 4, Strongly agree.

**AIDS-related knowledge**

AIDS knowledge was assessed using 19-items that included basic knowledge of HIV disease processes, transmission risks, medications and viral load (Carey and Schroder, 2002). All items were responded to Yes, No, or Don’t Know, with Don’t Know responses scored incorrect. We computed a score to reflect the number of items responded to correctly, $\alpha = 0.62$.

**Results**

**Score distribution and reliability**

The mean score on the pictographic self-efficacy scale averaging across all six scenarios was 176.0 (SD = 38.0). The Skewness statistic was $-1.0$ (SE = 0.26), indicating a slightly asymmetrical distribution with greater frequencies of lower self-efficacy scores. Kurtosis was 0.9 (SE = 0.51), indicating that the distribution tails were slightly longer than would be expected in a normal distribution (see Figure 2). The total scale was internally consistent, $\alpha = 0.68$.

With respect to time stability, Time 1 to Time 2 correlations for individual self-efficacy items ranged from $r(80) = 0.33$, $P < 0.01$ for the first unexpected visit scenario to $r(80) = 0.72$, $P < 0.01$ for the second oversleeping scenario. The 2-week test–re-test correlation for the total scale was $r(80) = 0.63$, $P < 0.01$. The difference between Time 1 and Time 2 total scores was not significant, $t(80) = 0.45$, $P > 0.1$.

**Differences between situation demands of the scenarios**

The correlations between less difficult gradations and the more difficult second gradations were significant, $r(86) = 0.76$, $P < 0.01$. To test whether the first gradations in each set resulted in higher self-efficacy ratings than the second gradations we compared within subjects mean responses. Results showed that the first gradations obtained significantly higher self-efficacy ratings ($M = 573.6$, SD = 116.5) than the second gradations ($M = 480.5$, SD = 128.2), $t(85) = 10.0$, $P < 0.01$.

**Convergent and divergent validity**

Results from the correlations between the pictographic subscales for less difficult gradations, more difficult gradations and total scores with the standard medication adherence self-efficacy scale obtained in Study 1.
scale indicated reasonable correspondence between the two measures of medication adherence self-efficacy (see Table II). Importantly, correlations between the total pictographic self-efficacy scale and its subscales with the three divergent self-efficacy scales did not indicate any significant associations. In addition, the pictographic self-efficacy scale was not associated with AIDS-related knowledge.

**Criterion-related validity**

Comparisons between persons who did not miss their antiretroviral medications in the past week \((N = 61)\) and those who did miss their medications during that time \((N = 20)\) showed that individuals who missed their medications obtained significantly lower self-efficacy scores for the two situation gradations subscales as well as for the total pictographic self-efficacy score (see Table III).

### Table II. Correlations among pictographic HIV treatment self-efficacy scores, standard scales of convergent and divergent self-efficacy, and AIDS knowledge \((N = 81)\)

<table>
<thead>
<tr>
<th>Pictographic self-efficacy scale</th>
<th>Standard and divergent self-efficacy scales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total score</td>
<td>Standard adherence</td>
</tr>
<tr>
<td>More demanding scenes</td>
<td>0.02</td>
</tr>
<tr>
<td>Less demanding scenes</td>
<td>0.04</td>
</tr>
<tr>
<td>AIDS knowledge</td>
<td>−0.07</td>
</tr>
<tr>
<td>SE for safer sex</td>
<td>0.01</td>
</tr>
<tr>
<td>SE for disclosure decisions</td>
<td>−0.07</td>
</tr>
<tr>
<td>SE for engaging in care</td>
<td>0.39</td>
</tr>
<tr>
<td>Standard SE for adherence</td>
<td>0.90</td>
</tr>
<tr>
<td>Less demanding scenes</td>
<td>0.90</td>
</tr>
<tr>
<td>More demanding scenes</td>
<td>0.95</td>
</tr>
</tbody>
</table>

\(a P < 0.01, \ b P < 0.05.\)

### Table III. Self-efficacy scores among persons who did not and who did miss their medications in the past week

<table>
<thead>
<tr>
<th>Did not miss medications ((n = 61))</th>
<th>Missed medications ((n = 20))</th>
<th>(t)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(M)</td>
<td>SD</td>
</tr>
<tr>
<td>Less demanding gradations</td>
<td>596.9</td>
<td>92.2</td>
</tr>
<tr>
<td>More demanding gradations</td>
<td>505.5</td>
<td>120.4</td>
</tr>
<tr>
<td>Total mean self-efficacy</td>
<td>184.2</td>
<td>32.9</td>
</tr>
</tbody>
</table>

\(^a P < 0.01.\)

### Study 2: Convergent, divergent and criterion-related validity

The second study was conducted to replicate the reliability statistics observed in Study 1, and to perform additional analyses of construct and criterion-related validity. In this study, we also focused on correlating the pictographic self-efficacy scores with potential confounding variables related to skills and abilities related to following the logic of the story or responding to the color bar scale, such as reading and numerical literacy, functional health, and neurocognitive indicators. Gender was also assessed as a potential confound because one set of scenarios was used for both men and women. We also examined the construct and criterion-related validity of the pictographic self-efficacy scale by performing correlations with indicators of medication adherence and by again comparing participants
who had missed their medications to persons who had not missed their medications. This study was also IRB approved.

**Methods**

**Participants**

Participants were 43 men and 21 women living with HIV-AIDS recruited from AIDS clinical and community support services. The mean age was 42.9 (SD = 7.2, range 30–64). Eighty-nine percent (n = 55) of participants were African-American, 8% (n = 5) were white and 3% (n = 2) were of other ethnicities. The average years of completed education was 11.8 (SD = 1.9), with 32% (n = 20) of participants not completing high school; 83% were currently unemployed or on disability and 86% had annual incomes under $10,000.

**Demographics and health status measures**

Participants completed the same demographic measures reported in Study 1. We also assessed whether participants were experiencing 20 different medication side-effects and whether they had experienced 14 specific symptoms of HIV infection. Participants also provided permission to contact their health care providers to access their most recent CD4 and viral load lab results to provide an objective index of their health status.

**HIV treatment adherence measures**

Participants were interviewed to identify the HIV treatments they were currently taking and the doses taken in the past 3 days (Chesney et al., 2000). First, participants were asked to name the drugs they were taking. Next, trained interviewers asked participants to confirm the drugs they were taking by identifying their treatments among pictures of drugs shown on a chart. The interviewer proceeded to ask participants to think back about what they did yesterday and recall the times they had taken each drug. A daily calendar was used to help participants cue their memory and structure their responses. Interviewers recorded the number of doses reportedly taken yesterday for each drug repeated for the day before yesterday and the day before that. The number of pills missed in the past 3 days was summed. In addition, participants were asked the number of pills missed in the past month and the time since the participant last missed taking their medications.

**Potential confounds**

A number of measures were administered to examine potential confounding variables with pictographic self-efficacy scale responses. We assessed reading ability and reading comprehension using the Wide-Range Achievement Test [WRAT-3 (Wilkinson, 1993)] and the Test of Functional Health Literacy for Adults [(TOFHLA (Parker et al., 1995). The numerical literacy subscale of the TOFHLA was also administered (Baker et al., 1997). The physical limitations and physical energy subscales of the SF-36 (Ware et al., 1993) were scored as markers for functional health status. We also assessed depression using the Center for Epidemiological Studies Depression (CESD) scale, a 20-item scale that assesses symptoms of depression over the previous 7 days (Radloff and Locke, 1986). Trails Test A and B (D’Elia et al., 1996) and the Clock Test (Schramm et al., 2002) were administered as measures of gross neurocognitive functioning.

**Face validity**

To determine the perceived relevance and realism of the pictographic scale scenarios, participants were asked if they had ever been in a situation like the one depicted in the scene, whether the situation was realistic and understandable, and whether they could relate to the characters presented in the situation.

**Results**

Comparisons of men (M = 154.6, SD = 42.2) and women (M = 161.4, SD = 47.1) on total self-efficacy scores did not indicate significant differences, t(61) = 0.58, P > 0.1. Comparisons between men and women on the less demanding and more demanding gradation subscales also did not indicate significant differences. On average, the sample demonstrated low levels of reading literacy (missing 17% on the TOFHLA) and moderate levels of
depression (mean CESD score = 18.2, with a cut-off of 16 for moderate depression).

**Differences between situation gradations**

As expected, the first scenarios and their second more demanding gradations were significantly correlated, \( r(63) = 0.74, P < 0.01 \). Comparisons of means on the less demanding gradations and more demanding gradations again showed that self-efficacy scores on the more demanding gradations (\( M = 141.4, SD = 49.0 \)) were significantly lower than scores on the less demanding gradations (\( M = 171.6, SD = 44.1 \)), \( t(62) = 7.1, P < 0.01 \).

**Reliability**

The total pictographic self-efficacy score was internally consistent, \( \alpha = 0.72 \). Table IV shows that the \( \alpha \) coefficients if individual items were deleted indicated that no single item was inflating the internal consistency of the total scale.

Also shown in Table IV are the inter-item correlations and corrected item-to-total correlations, indicating no signs of item redundancy and response dispersal. In addition, the Skewness and Kurtosis statistics indicated symmetric distributions (see Figure 3).

**Tests for confounds**

Table V shows the correlations for the two self-efficacy subscales and the total score with tests of literacy, neuropsychological performance and functional health. None of the self-efficacy scores was associated with any of these potential confounds. Thus, self-efficacy ratings seemed unrelated to education, reading literacy, numerical literacy, medication side effects, HIV symptoms, physical condition, depression or neurocognitive functioning.

**Face validity**

Participants were asked questions pertaining to their impressions of the scenarios and pictographs included in the adherence self-efficacy assessment (see Table VI). Nearly all participants indicated that the scenarios were realistic, that they could relate to the situations and that the scenarios were understandable. In addition, a majority of participants indicated that they had been in similar situations for each scene and there was variability in terms of whether participants had experienced difficulty taking their medications in similar situations for each scenario.

### Table IV. Inter-item correlations, item distribution characteristics and \( \alpha \) coefficients if items deleted

<table>
<thead>
<tr>
<th></th>
<th>Run into an old friend</th>
<th>Run into an old lover</th>
<th>Over sleep with meds near</th>
<th>Over sleep with meds far</th>
<th>Go out with a friend for 3 drinks</th>
<th>Go out with a friend for 7 drinks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go out with a friend for 7 drinks</td>
<td>0.35(^a)</td>
<td>0.38(^a)</td>
<td>0.09</td>
<td>0.24(^b)</td>
<td>0.48(^a)</td>
<td>–</td>
</tr>
<tr>
<td>Go out with a friend for 3 drinks</td>
<td>0.38(^a)</td>
<td>0.48(^a)</td>
<td>0.03</td>
<td>0.13</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Over sleep with meds far</td>
<td>0.20</td>
<td>0.11</td>
<td>0.67(^a)</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Over sleep with meds near</td>
<td>0.15</td>
<td>0.11</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Run into an old lover</td>
<td>0.76(^a)</td>
<td>–</td>
<td></td>
<td></td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Mean</td>
<td>184.0</td>
<td>172.3</td>
<td>204.8</td>
<td>188.9</td>
<td>126.1</td>
<td>63.9</td>
</tr>
<tr>
<td>SD</td>
<td>53.4</td>
<td>69.5</td>
<td>56.0</td>
<td>61.8</td>
<td>83.6</td>
<td>75.8</td>
</tr>
<tr>
<td>Skewness</td>
<td>−0.69</td>
<td>−0.83</td>
<td>−2.2</td>
<td>−1.4</td>
<td>−0.02</td>
<td>1.5</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>−0.36</td>
<td>−0.35</td>
<td>4.1</td>
<td>1.5</td>
<td>−1.4</td>
<td>0.87</td>
</tr>
<tr>
<td>Item-to-total correlation</td>
<td>0.58</td>
<td>0.57</td>
<td>0.28</td>
<td>0.37</td>
<td>0.47</td>
<td>0.49</td>
</tr>
<tr>
<td>( \alpha ) if deleted</td>
<td>0.65</td>
<td>0.64</td>
<td>0.72</td>
<td>0.70</td>
<td>0.68</td>
<td>0.67</td>
</tr>
</tbody>
</table>

\(^a\)P < 0.01, \(^b\)P < 0.05.
Criterion-related validity

Table VII shows the correlations among the two medication adherence self-efficacy subscales, and the total score with behavioral and biological markers of medication adherence. Results showed that self-efficacy scores were associated with missed medications, days since medications were missed, and chart abstracted viral load. All of the correlations were in the direction of higher self-efficacy being associated with better HIV treatment adherence.

Comparisons of participants who did not miss their medications in the past 3 days with those who did miss their medications during that time period on the self-efficacy subscales and total scores showed that individuals who had missed their medications reported significantly lower self-efficacy responses on the less demanding situations and on the total score, with a trend toward significant difference for the more demanding gradations (see Table VIII).

Limitations

Interpretation of the study findings requires attention to their methodological limitations. First, the studies presented here are limited by their reliance on self-reported medication adherence. Without an objective measure of medication adherence in addition to viral load it is possible that the observed correlations between medication adherence and self-efficacy are artifacts of response biases. Second, the studies had relatively small sample sizes, potentially limiting generalizability of the scale development analyses. Another methodological limitation is the discontinuity of time frames for the self-efficacy and adherence behaviors. Specifically, self-efficacy is assessed for the present, with individuals indicating how confident they currently feel. In contrast, all of the adherence measures referred to pills missed over a retrospective time frame. The data therefore do not allow for any causal inferences.

The current studies also identified areas for further development of the pictographic medication adherence self-efficacy scale.

Table V. Correlations among pictographic self-efficacy scores and potential confounding participant characteristics

<table>
<thead>
<tr>
<th></th>
<th>Less demanding gradations</th>
<th>More demanding gradations</th>
<th>Total score</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literacy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>education WRAT</td>
<td>-0.09</td>
<td>-0.02</td>
<td>-0.15</td>
<td>11.8</td>
<td>1.9</td>
</tr>
<tr>
<td>TOFHLA-R (% correct)</td>
<td>-0.16</td>
<td>-0.12</td>
<td>-0.17</td>
<td>83.3</td>
<td>18.4</td>
</tr>
<tr>
<td>TOFHLA-N (% correct)</td>
<td>-0.12</td>
<td>-0.07</td>
<td>-0.14</td>
<td>76.7</td>
<td>16.2</td>
</tr>
<tr>
<td>Functional health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>medication side-effects</td>
<td>0.07</td>
<td>0.11</td>
<td>0.03</td>
<td>11.2</td>
<td>10.2</td>
</tr>
<tr>
<td>HIV symptoms</td>
<td>-0.03</td>
<td>0.06</td>
<td>-0.10</td>
<td>14.5</td>
<td>13.5</td>
</tr>
<tr>
<td>SF-36 limits</td>
<td>0.15</td>
<td>0.22</td>
<td>0.16</td>
<td>6.3</td>
<td>5.2</td>
</tr>
<tr>
<td>SF-36 energy</td>
<td>-0.03</td>
<td>-0.02</td>
<td>-0.02</td>
<td>22.8</td>
<td>5.6</td>
</tr>
<tr>
<td>Depression score</td>
<td>0.12</td>
<td>0.10</td>
<td>0.12</td>
<td>18.2</td>
<td>12.2</td>
</tr>
<tr>
<td>Trails A</td>
<td>0.11</td>
<td>0.07</td>
<td>0.13</td>
<td>76.4</td>
<td>43.2</td>
</tr>
<tr>
<td>Trails B</td>
<td>0.15</td>
<td>0.14</td>
<td>0.13</td>
<td>134.1</td>
<td>94.9</td>
</tr>
<tr>
<td>Clock Test</td>
<td>0.18</td>
<td>0.20</td>
<td>0.14</td>
<td>7.7</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Mean 156.5 171.6 141.44
SD 43.4 44.1 49.0
Skewness -0.02 -0.31 0.36
Kurtosis 0.01 -0.09 -0.11

Fig. 3. Distribution of scores from the pictographic medication adherence self-efficacy scale obtained in Study 2.
adherence self-efficacy scale. We found that the graded scenes for situation demands were not universally more difficult than the situations assumed less demanding. For example, some participants stated that it would be easier to leave and take their medications if they were visiting with a former lover than with an old friend. It may also be easier for some people to get out of bed to get their medications than to roll over and possibly fall asleep before taking their medications at their bedside. Finally, although the drinking scenes clearly pose the greatest challenge to taking medications, the scenes may be less relevant for people who do not drink and many people do not drink while taking medications to avoid adverse reactions. Despite these limitations, we believe that the pictographic medication self-efficacy scale has implications for improving the assessment of self-efficacy in diverse populations.

### General discussion

Results of Studies 1 and 2 showed that the pictographic medication adherence self-efficacy scale developed in this research was internally consistent and possessed distributional characteristics that approximated normal. The self-efficacy scale also appeared face valid, with participants identifying with the scenes and recognizing the difficulties of adhering to medications within the situations. Results also provided evidence for the construct and criterion-related validity of the self-efficacy scale.
Pictographic self-efficacy scores were associated with behavioral measures of medication adherence and chart abstracted lab results for viral load—a biological marker for HIV treatment adherence. Importantly, the self-efficacy scale was not associated with potential confounding factors in medication adherence including reading and numerical literacy, education, and health status including functional health, depression, neurocognitive functioning, CD4 cell counts, HIV symptoms and medication side-effects. These findings provided evidence for the reliability and validity of the pictographic medication adherence self-efficacy scale.

The pictographic self-efficacy scale was developed for use with persons who have limited reading abilities as well as other language challenges. However, we believe that the scale may have a more generalized use than those that we originally had in mind. The scale has internally valid situational gradations of task demands, normal distributions of scores and yields interval level data. The pictographic self-efficacy scale may therefore be adaptable to other chronic medical populations, particularly patient populations that require long-term medications, such as diabetes and asthma. Future research is needed to investigate the adaptability of the scale for various medical populations.

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