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Brief Mood Introspection Scale (BMIS): Technical and Scoring Manual (3rd Edition)

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Brief Mood Introspection Scale (BMIS): Technical and Scoring Manual (3rd Edition)

By John D. Mayer and Rachael Cavallaro, 26 February, 2019

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Part 1: Description of the Brief Mood Introspection Scale (BMIS)

What the BMIS Looks Like

Before you start, it is helpful to download a copy of the BMIS in PDF or WORD format). Figure 1 provides a reasonable facsimile of the scale.

Note that the scale is composed of instructions, followed by a response scale that goes: XX, X, V and VV. This is the "Meddis" response scale (named after its originator). Meddis (see credit under Figure 1) demonstrated that the alternatives, used with the labels shown below, go some way toward eliciting a normally distributed response profile across the four choices.

Brief Mood Introspection Scale (BMIS)
by John D. Mayer

INSTRUCTIONS: Circle the response on the scale below that indicates how well each adjective or phrase describes your present mood.

(definitely do not feel) (do not feel) (slightly feel) (definitely feel)

XX X V VV

Lively	XX X V VV	Drowsy	XX X V VV
Happy	XX X V VV	Grouchy	XX X V VV
Sad	XX X V VV	Peppy	XX X V VV
Tired	XX X V VV	Nervous	XX X V VV
Caring	XX X V VV	Calm	XX X V VV
Content	XX X V VV	Loving	XX X V VV
Gloomy	XX X V VV	Fed up	XX X V VV
Jittery	XX X V VV	Active	XX X V VV

Figure 1. A copy of the BMIS
Original scale as described in Mayer, J. D., & Gaschke, Y. N. (1988). The experience and meta-experience of mood. *Journal of Personality and Social Psychology*, *55*, 102-111. The Meddis response scale was discussed in Meddis, R. (1972). Bipolar factors in mood adjective checklists. *British Journal of Social Clinical Psychology*, *11*, 178-184.

The four-point Meddis response scale is coded as a four-point scale such that *XX* is set equal to 1, *X* to 2, *V* to 3 and *VV* to 4.

The Four Scale Scores

Four subscores can be computed from the BMIS: Pleasant Unpleasant, Arousal-Calm, Positive-Tired and Negative-Relaxed Mood. Each score is computed from a different scale (set of items) containing a different number of items, as indicated in Table 1.1. Pleasant-Unpleasant uses all 16 items, Arousal-Calm, 12 items, Positive-Tired, 7-items, and Negative-Relaxed, 6 items.

Table 1.1

The BMIS items and the scales they fall on.

	The Four BMIS Factor-Based Subscales: Two Pairs of Scales							
	Pair 1: Unrotated Two-Factor Solution				Pair 2: Varimax-Rotated Two-Factor Solution			
The 16 BMIS Mood Adj.	***Pleasant-Unpleas.***		***Arousal-Calm***		***Positive-Tired***		***Negative-Relaxed***	
	Positively-Worded Items	Negatively-Worded Items	Positively-Worded Items	Negatively-Worded Items	Positively-Worded Items	Negatively-Worded Items	Positively-Worded Items	Negatively-Worded Items
Lively	x		x		x			
Happy	x							
Sad		x	x				x	
Tired		x		x		x		
Caring	x		x		x			
Content	x							
Gloomy		x	x				x	
Jittery		x	x				x	
Drowsy		x				x		
Grouchy		x						
Peppy	x		x		x			
Nervous		x	x				x	
Calm	x			x				x
Loving	x		x		x			
Fed up		x	x				x	
Active	x		x		x			
Totals								
PW Items	8		10		5		4	
NW items		8		2		2		1
Scale Total	16		12		7		6	

Some items on each scale are scored in the opposite direction from standard: On the Pleasant-Unpleasant scale, for example, happy is scored "as is" and sad is scored opposite to what the participant says (so that the higher the sadness, the more is *deducted* from the overall pleasantness of the person's mood).

Negatively-worded items (also known as oppositely-scored) items can be scored either by using *reverse scoring* or *subtractive scoring*. We currently recommend *reverse scoring* the opposite items relative to the as-is items.

Obtaining the BMIS

The BMIS is open-source to qualified researchers. If you meet the criteria in Table 1.2, you may use a copy of the BMIS from our laboratory website (at mypages.unh.edu/jdmayer), or simply copy the items from this document and use those as your survey.

Table 1.2

Conditions for Use of the BMIS

Conditions for Use: The BMIS is "open source" to qualified researchers for research evaluated as ethical according to the researchers' Institutional Review Board. Our "open source" policy extends to qualified, competent researchers with training in the use of psychological tests. This includes many psychologists, physicians, nurses, and social workers, as well as others with related relevant disciplinary training, whose research falls under the supervision of an Institutional Review Board to ensure the ethical treatment of human participants. If you are in a private firm, please ensure that someone on your team qualifies as indicated. Note that your organization may be able to secure the services of a private Ethics Review Board. If you are an undergraduate or graduate student, please be sure you are working under the supervision of a qualified individual, as described above, and that they are informed about your work before you begin.

Part 2. Four Ways to Implement the BMIS

Overview and Issues

Over time, researchers have employed the BMIS with two different response scales, and used two different ways of scoring the BMIS test, resulting in four possible ways the test could be implemented and analyzed. The alternative response scales involved either following each mood adjective with the original 4-point Meddis response scale, or using a modification of the Meddis response scale that employed a 7-point rather than 4-point approach. (The original Mayer & Gaschke (1988) article used the 4-point scale but text of the article suggested that if greater test reliability were needed for a particular scale, a 7-point version of the Meddis scale could replace the 4-point scale. As a consequence, the scale has been used both ways).

Key Advisory

Reverse scoring (recommended) correlates $r = 1.0$ with subtractive scoring. To see how to convert from one method to the other, please refer to the later chapters of this manual.

Subtractive versus Reverse Scoring. The BMIS is scored using both subtractive and reverse scoring. Although the original article containing the BMIS recommended subtractive scoring (Mayer & Gaschke, 1988), reverse scoring is now the recommended mode of scoring the test.

Reverse Scoring. Reverse scoring refers to identifying items that measure the polar opposite of the dominant end of a scale (for example, “Unpleasant” Items on a Pleasant-Unpleasant Mood scale), and then reversing the scale values for those opposite items. In the case of the BMIS using a 4-point scale, it involves rescoring items such as “Sad”

(representing the "opposite" of the dominant Pleasant end of the scale) by reassigning a 4 as a 1, a 3 as a 2, a 2 as a 3, and a 1 as a 4 as indicated in Table 2.1.

Table 2.1

Simple Example of Reverse Scoring a 4-point Likert Scale

Response	Definitely do not feel			Definitely feel
Original	1	2	4	4
Reversed	4	3	2	1

The same information is indicated for the 7-point version of the response scale in Table 2.2.

Table 2.2

Simple Example of Reverse Scoring a 7-point Likert Scale

Response	Definitely do not feel						Definitely feel
Original	1	2	4	4	5	6	7
Reversed	7	6	5	4	3	2	1

In subtractive scoring, The conversions for both the 4-point response scales are transposed to the left columns of Table 2.2.

Subtractive Scoring. Subtractive scoring is common in situations in which both endorsements of the positively- and negatively-worded items on a scale constitute separate scores of interest. In such a case, as with pleasant and unpleasant mood, and with positive- and negative- self-esteem, sums of the positively- and negatively-worded items are summed separately and then the overall score is determined by taking the score of the positively-worded items and subtracting from it the score on the negatively-worded items (C.E. Noll & Bradburn, N. M., 1970; Schmitt & Allik, 2005).

Applying subtractive scoring step-by-step in the case of the BMIS, one would:

- add together all the scores for the pleasant mood words (e.g., Lively, Happy, Peppy, etc.)
- add together all the scores for the negative mood words (e.g., Sad, Tired, Jittery, etc.), and
- then subtract the unpleasant total from the pleasant total to calculate the total score.

(Note that the procedure is algebraically equivalent to changing the sign on each opposing item, such that 1 becomes -1, 2 becomes -2, and so on, so that all the items that measure in the opposite direction of the dominant end of the scale (such as Sad on the Pleasant scale) are rendered negative. In this alternative approach, the individual items are added up for a total score).

The overall process is indicated in Table 2.3.

Table 2.3

Scoring Items on a 4-Point Response Scale

Step1		**Step 2**	
In Subtractive Scoring, (1) All Items First are Scored as Is		Then, (2) Each Participant's Responses are Scored for Each Part of the Test	
Positively-Worded Items	Negatively-Worded Items	Positively-Worded Items	Negatively-Worded Items
1	1	3	4
2	2	3	2
3	3	2	1
4	4	3	1
		Sum: 11	Sum: 8
Step 3			
Lastly, the sum of the negatively-scored items is subtracted from that of the positively-scored items. In this example (3) 11-8 = 3, which is the overall score			

Reverse scoring appears, in hindsight, to be a more elegant procedure than simple subtraction, but subtraction works as well. For that reason, we recommended reverse-scoring in online documents regarding the BMIS after the scale was published.

Part 3. Recommended Scoring: The Reverse-Scoring Method

Score the Pleasant-Unpleasant Scale

Referring to Figure 1, score the Pleasant-Unpleasant scale using these steps:

1. Convert the Meddis response scale (XX, X, V, VV) to numbers:
XX = 1
X = 2
V = 3
VV = 4

2. Next, reverse score the responses for: Drowsy, Fed up, Gloomy, Grouchy, Jittery, Nervous, Sad, and Tired. That is, recode, such that:
XX = 4
X =3
V = 2
VV = 1

3. Now, add up the scores for all 16 items to obtain the scale score. The sum is the total score on the Pleasant-Unpleasant scale.

Score the Arousal-Calm Mood Scale

1. Convert the Meddis response scale to numbers this way:
XX = 1
X = 2
V = 3
VV = 4

2. Next, add up the responses for:
2. Next, reverse score the responses for: Calm, Tired. That is, recode, such that:
XX = 4
X =3
V = 2
VV = 1

3. Now, add up the scores for the following items (as is): Active, Caring, Fed up, Gloomy, Jittery, Lively, Loving, Nervous, Peppy, and Sad; (reverse-scored) Calm and Tired. The total represents the Arousal-Calm scale score.

Scoring the BMIS for Positive-Tired Mood

1. Convert the Meddis response scale to numbers this way:
XX = 1

X = 2
V = 3
VV = 4

2. Next, reverse score the responses for: Drowsy and Tired. That is, recode, such that:
XX = 4
X =3
V = 2
VV = 1

3. Now, add up the scores for the as-is adjectives Active, Caring, Lively, Loving, and Peppy, and the reverse scored items Drowsy and Tired. That is the total on the Positive-Tired scale

Scoring the BMIS for Negative-Relaxed Mood

1. Convert the Meddis response scale to numbers this way:
XX = 1
X = 2
V = 3
VV = 4

2. Next, reverse score the responses for: Calm. That is, recode, such that:
XX = 4
X =3
V = 2
VV = 1

3. Now, add up the scores for the as-is items Fed up, Gloomy, Jittery, Nervous, and Sad and the reversed-scored item, Calm. That is the total score on the Negative-Relaxed scale.

Part 4. Calculating the Range of 4-Point and 7-Point Scales that Use Reverse and Subtractive Scoring

Worded (PW) and Negatively-Worded (NW) Items

Many tests such as the BMIS make use of both "as is" or positively-worded (PW) items and reverse-scored or negatively-worded (NW) items. Each BMIS scale contains a different number of items we can designate as *K* items. Positively-worded items are those that are scored without alteration. For example, on the Pleasant-Unpleasant scale of the BMIS, a person's endorsement of the adjective "Happy," on the 4-point Meddis response scale can be added into the total test score as is, because happier people will be more inclined to endorse 3 or 4 on the measure, and that will directly add to their overall pleasantness score. People who endorse "Sad," on the other hand, need to have their score reversed, because their 4 (for example) represents a *lack* of pleasant affect, and so the response is reversed to represent a "1" response.

To generalize these ideas, and to treat them more formally, we can characterize a response scale made up of multiple items using the terms indicated in Table 4.1.

Table 4.1

Key Symbols and Terms

K items	The overall number of items on a scale
PW items	The number of "as is" (i.e., positively-worded) items, and
NW items	The number of negatively-worded (i.e., opposite-worded) items
MinRsp	The minimum response value for an item (e.g., 1 on the 4-point scale)
MaxRsp	The maximum response value for an item (e.g., 4 on the 4-point scale)
TSmin	The minimum value for a test scale
TSmax	The maximum value for a test scale

Placeholder text between table and narrative

Calculating the Range of Scores for Reverse Scoring of the 4-Point Scale

Under conditions of reverse scoring (and after reversing the negatively-worded items), the minimum and maximum scores on the BMIS, using the 4-point scale, can be easily estimated using the following two equations:

Equations 4.1 and 4.2

The Minimum and Maximum Values of a Reverse-Scored Scale

TSmin = K x MinRsp (Equation 4.1)
TSmax = K x MaxRsp (Equation 4.2)

where:

K: The overall number of items on a scale
MinRsp: The minimum response value for an item (e.g., 1 on the 4-point scale)
MaxRsp: The maximum response value for an item (e.g., 4 on the 4-point scale)
TSmin: The minimum value for a test scale
TSmax: The maximum value for a test scale

Table 4.2 provides the ranges for the four BMIS scales using a 4-point response scale. The left-most columns of the table indicates the scale names, and the minimum and maximum response possible for each item on the scales (always 1 for the minimum and 4 for the maximum). Equations 4.1 and 4.2 can then be used to calculate the minimum and maximum score for each of the test's four scales. For the Positive-Tired scale, as an example, there are 7 items overall. The range is therefore from (7 x MinRsp) to (7 x MaxRsp) or from 7 x 1 to 7 x 4; that is, from 4 to 28. That, along with values for the remaining scales, are in the right-most columns of Table 4.2.

Table 4.2

Ranges for BMIS Scales Using Reverse Scoring and a 4-Point Response Scale

	Item Response Scale		Items on Scale	Total Scale Scores	
	Item Min	Item Max	Total Items	Min	Max
Symbol	MIN_{rsp}	MAX_{rsp}	K	TS_{min}	TS_{max}
BMIS Scales					
Pleasant-Unpleasant	1	4	16	16	64
Arousal-Calm	1	4	12	12	48
Positive-Tired	1	4	7	7	28
Negative-Relaxed	1	4	6	6	24

The case of the seven-point response scale

The calculations for the 7-point scale are similarly straightforward (after reversing negatively-worded items). For the Positive-Tired scale, the same 7 items are relevant, but now the response maximum is 7 (rather than 4 in the earlier example). These values can be found in the left columns of Table 4.3. For the Positive-Tired scale, the range is therefore from (7 x MinRsp) to (7 x MaxRsp) or from 7 x 1 to 7 x 7; that is, from 7 to 49. This result is indicated in Table 4.3 in the "Reverse Scoring" column, along with the results for the other three BMIS scales.

Table 4.3

Ranges for BMIS Scales Using Reverse Scoring and the 7-Point Response Scale

	Item Response Scale		Items on Scale	Total Scale Scores	
	Item Min	Item Max	Total Items	Min	Max
Symbol	MIN_{rsp}	MAX_{rsp}	K	TS_{min}	TS_{max}
BMIS Scales					
Pleasant-Unpleasant	1	7	16	16	112
Arousal-Calm	1	7	12	12	84
Positive-Tired	1	7	7	7	49
Negative-Relaxed	1	7	6	6	42

Calculating the Range of Scores for Subtractive Scoring

The case of the 4-point response scale

The calculation of minimum and maximum values for substractive scoring are a bit different—and a bit more involved—although still fairly straightforward. This time, the two equations become as indicated in Equations 4.3 and 4.4.

Equations 4.3 and 4.4.

Equations for the Minimum and Maximum Values of a Subtractive-Scored Scale (*TSmin and TSmax)*

TSmin = (PW x MinRsp) – (NW x MaxRsp) (Equation 4.3)
TSmax = (PW x MaxRsp) – (NW x MinRsp) (Equation 4/4)

where:

TSmin: The minimum value for a test scale
TSmax: The maximum value for a test scale
MinRsp: The minimum response value (e.g., 1 on a 4-point scale)
MaxRsp: The maximum response value (e.g., 4 on the 4-point scale)
PW items: The number of positively-worded (or "as is") items, and
NW items: The number of negatively-worded (or opposite-scored) items.

Again using the Positive-Tired scale as an example, there are 7 items overall, PW=5 and NW=2. The minimum response is 1 and maximum is 4, yielding a minimum possible total on the scale of *Minimum Value* = (5 x 1) – (2 x 4) = 5-8 or -3. The maximum value would be *Maximum Value* = (5 x 4) – (2 x 1) = 18. These values and those for the remaining scales are indicated in the right of Table 4.4.

Table 4.4

Ranges for BMIS Scales *Using the Subtractive Method* with 4-Point Response Alternatives

	Response Scale		Number of Items on Scale			Range of Values for Scoring Approach						
BMIS Scales	Min rsp	Max rsp	Over-all (K)	PW	NW	Intermediate Calculations				Min. Value[a]	Max. Value[b]	Check[c]
						PW x MinRsp	NW x MaxRsp	PW x MaxRsp	NW x MinRsp			
Pleasant-Unpleasant	1	4	16	8	8	8	32	32	8	-24	24	48/16=3
Arousal-Calm	1	4	12	10	2	10	8	40	2	2	38	36/12=3
Positive-Tired	1	4	7	5	2	5	8	20	2	-3	18	21/7=3
Negative-Relaxed	1	4	6	5	1	5	4	20	1	1	19	18/6=3

Key Abbreviations: PW, positively-worded items (scored as is); NW, negatively-worded items (scored oppositely): MinRsp and MaxRsp, the minimum and maximum values on the Likert response scale; K, the total number of items on the scale

[a](PW x MinRsp) – (NW x MaxRsp)

[b](PW x MaxRsp) – (NW x MinRsp)

[c]Range of the Response Rating Scale = [(MaxRsp-MinRsp)/K] + 1

It turns out that work in this area can be readily checked in the following way: Take the range of possible total scores (scale maximum – scale minimum value; that is, MaxRsp-MinRsp). Next, divide that by the *total* number of items on the scale, *K*. The results should be the range of the response scale minus 1 (i.e., 4 - 1, or 3 in this case). As you can see the computations in Table 4.4 all satisfy the check.

The case of the 7-point response scale

Next, let's examine the case of the 7-point scale. Table 4.5, right-hand side columns, contain the parallel computations for the 7-point scale. Once again, the check works out; that is, the Range of the Response Rating Scale = MaxRsp-MinRsp/K + 1 = 6 + 1, or 7, in each case.

Table 4.5

Ranges for BMIS Scales *Using the Subtractive Method* with 7-Point Response Alternatives

	Response Scale		Number of Items on Scale			Range of Values for Scoring Approach						
BMIS Scales	Min	Max	Over-all	PW items	Reverse scored	Intermediate Calculations				Min. Value[a]	Max. Value[b]	Check[c]
						PW x MinRsp	NW x MaxRsp	PW x MaxRsp	NW x MinRsp			
Pleasant-Unpleasant	1	7	16	8	8	8	56	56	8	-48	48	96/16=6
Arousal-Calm	1	7	12	10	2	10	14	70	2	-4	68	72/12=6
Positive-Tired	1	7	7	5	2	5	14	35	2	-9	33	42/7=6
Negative-Relaxed	1	7	6	5	1	5	7	35	1	-2	34	36/6=6
Variable Name	Min Rsp	Max Rsp	K	PW	NW							

Key Abbreviations: PW, positively-worded items (scored as is); NW, negatively-worded items (scored oppositely): MinRsp and MaxRsp, the minimum and maximum values on the Likert response scale; K, the total number of items on the scale

[a](PW x MinRsp) – (NW x MaxRsp)

[b](PW x MaxRsp) – (NW x MinRsp)

[c]Range of the Response Rating Scale = [(MaxRsp-MinRsp)/K] + 1

Part 5. Translating Between 4- and 7-Point Scales When Item-Level Data is Available

In situations where one has item-level information available, it is possible to convert from a 4 to a 7-point, or a 7 to a 4-point scale on a response-by-response basis. In this instance, each response is recoded so that it matches the range of the desired targeted scale. On the BMIS, the Meddis response scale 4- and 7-point scales can be compared to one another as indicated in Table 5.1.

Table 5.1

A Comparison of the 4- and 7-point BMIS scales

	definitely do not feel		do not feel		slightly feel		definitely feel
Scale Seen by Participants							
4-Point Scale	XX		X		V		VVV
7-Point scale	XXX	XX	X	XV	V	VV	VVV
Scale as Scored[a]							
4-Point Scale	1		2		3		4
7-Point scale	1	2	3	4	5	6	7

[a]Before any reversal for scoring

Example. If a participant responded with a "2" (do not feel) to Sad on a 4-point scale, that would become a "3" (do not feel) after conversion to a 7-point scale. Going in the reverse direction, one could be to convert from a "2" on the 7-point scale to a "1.5"—i.e., midway between the 1 and 2 response, on the 4-point scale.

Conversions from the 7- to the 4-Point Scale

To convert from one scale to another, one can recode the individual item-level responses. To go from the 7- to the 4-point scale, for example, one could recode as

follows, where "MOODAdj" is a variable name that can stand in for any mood adjective on the BMIS (or any item on any other scale). These are indicated in Table 5.2.

Table 5.2

Examples of SPSS syntax for Converting the 4-Point BMIS Scale to 7 points and Back Again

Software Help 5.1 and 5.2 A model for conversion of 4- to 7-point scales and back using the example of a recode statement in SPSS syntax

To go from the 4 to the7-point scale, one would recode as follows:

```
RECODE MOODadj (1=1) (2=1.5) (3=2) (4=2.5) (5=3) (6=3.5) (7=4)
```

And to go from the 4 to the7-point scale, one would recode as follows:

```
RECODE MOODadj (1=1) (2=3) (3=5) (4=7)
```

Other treatments also exist, sometimes with a somewhat different focus and approach (Sanbandam, 2006) but the ones here are relatively complete by comparison to reports elsewhere (Colman, Norris, & Preston, 1997; IBM Support, 2016).

Compatibility with the 2016 IBM Support Center Conception of Scale Translation

The formulae here and their results can be compared against an alternative approach advocated by IBM support for SPSS statistical software (IBM Support, 2016). The anonymous expert recommends transforming Likert scales to a common scale that goes from zero to one. To do so, one can use Equation 5.1.

Equation 5.1

IBM Support Formula for Likert Scale Transformation

$X = (x-a)/(b-a)$

Where:

x is the value on the original scale
X is the transformed scale value
a is the original Likert scale minimum and
b is the original Likert scale maximum

Using the above equation, Likert scale values for a 4-point scale are transformed as indicated in Table 5.3

Table 5.3

Converting a 4-Point Scale to a Scale from 0 to 1

x	a	b	x-a	b-a	X
1	1	4	0	3	0
2	1	4	1	3	.33
3	1	4	2	3	.67
4	1	4	3	3	1.0

And doing it again for 7-point scale, one would obtain the values indicated in Table 5.4.

Table 5.4

Converting a 7-Point Scale to a Scale from 0 to 1

x	a	b	x-a	b-a	X
1	1	7	0	6	0
2	1	7	1	6	.17
3	1	7	2	6	.33
4	1	7	3	6	.50
5	1	7	4	6	.67
6	1	7	5	6	.83
7	1	7	6	6	1

The IBM discussion further provides the transformation back to a Likert scale, as indicated in Equation 5.2.

Equation 5.2

IBM Support Formula for Transformation from a Scale from 0 to 1 to a Likert Scale

$Y = (b-a) * X + a$

Where:

Y is the value on the Likert scale
X is the value on the common scale: that is, from 0 to 1
a is the desired Likert scale minimum and
b is the desired Likert scale maximum

So, to take just one example, the ".33" value for the 4-point scale would be:

$Y = (4-1) * .33 + 1$ or

$Y = 3 * .33 + 1$; that is:

$Y = 1 + 1 = 2$.

The IBM-proposed method and the methods developed independently here are consistent with one another in key respects. These include that:

- Both convert the scales first so that they have true zero
- Both approaches indicate that the 7-point scale is "twice" as long as the 4-point scale once the true zero is taken into account, i.e., 0 to 3 vs. 0 to 6. (Another way to think about this is that the range of the 7-point scale (7 - 1 = 6) is twice that of the 4-point scale (4 - 1 = 3) and
- The equivalencies obtained across 4 and 7-point scales (i.e., that, in converting from the 4- to the 7-point scale 1 = 1, 2 = 3, 3 = 5 and 4 = 7) are in agreement.

Part 6. Converting between 7-Point and 4-Point Scales and/or Reverse and Subtractive Scoring

Overview

Many additional translations and conversions are possible between the 4- and 7-point response scales, beyond the conversion of individual response values of an item. This section presents the equations developed for converting individual scores and means between different response scales and scoring methods, using the BMIS scales as examples. It is important to mention that there is no difference converting between means and individual scores. From this point forward the term 'value' will refer to both means and individual scores, unless otherwise specified.

To convert a value between measurement scales (i.e. converting Celsius to Fahrenheit), the measurement scales' values need to be transformed from one to the other (i.e. (0°**C** * 9/5) + 32 = X°**F**) in order to directly compare them. When converting BMIS values, specific conversion equations are needed for each situation—for example, converting from a 7- to a 4-point scale, or from subtractive to reverse scoring for the 4-point scale. This is due to the fact that the BMIS's ranges of values have different midpoints depending on what combination of mood scale, response scale and scoring method is used. In order to transform BMIS values from one response scale and/or scoring method to another, both of their ranges need to be centered at zero, termed, zero-centered.

To successfully convert values between response scales and/or scoring methods, we use a several-step approach (formulas and step-by-step examples are below).

- In Step 1, the two ranges from the different response scales and/or scoring methods are calculated.
- In Step 2, the two ranges' midpoints are used to create zero-centered values for the specific response scale and scoring method.
- In Step 3, the zero-centered values from the two different response methods (i.e., from two specific scale and scoring approaches) are compared, and any further adjustments are made to equate the scales.
- In Step 4, integrating the above together, we arrive at a single equation that can be used to convert more directly from one response scales and/or scoring method to another.

In this section we will go through this several step process in detail and demonstrate how to convert a value between scoring methods (i.e. reverse scoring to subtractive scoring, both on a 7-point scale), between response scales (i.e. from a 7-point response scale to 4-point response scale), and both scoring methods and response scales (i.e. 7-point subtractive score to 4-point reverse score). All the information needed to calculate the conversions (expect for the formula) are provided in Table 6.1 and Table 6.2.

Table 6.1

Ranges and Midpoint for the four 4-Point BMIS Mood Scales Under Varied Conditions

	Reverse Scoring				Subtractive Scoring			
	Min	Max	Range	Mid point	Min	Max	Range	Mid point
Symbol	TS_{min}	TS_{max}	RNG	Midpnt	TS_{min}	TS_{max}	RNG	Midpnt
BMIS Mood Scales								
Pleasant-Unpleasant	16	64	48	40	-24	24	48	0
Arousal-Calm	12	48	36	30	2	38	36	20
Positive-Tired	7	28	21	17.5	-3	18	21	7.5
Negative-Relaxed	6	24	18	15	1	19	18	10

Table 6.2

Ranges and Midpoint for the four 7-Point BMIS Mood Scales Under Varied Conditions

	Reverse Scoring				Subtractive Scoring			
	Min	Max	Range	Mid point	Min	Max	Range	Mid point
Symbol	TS_{min}	TS_{max}	RNG	Midpnt	TS_{min}	TS_{max}	RNG	Midpnt
BMIS Mood Scales								
Pleasant-Unpleasant	16	112	96	64	-48	48	96	0
Arousal-Calm	12	84	72	48	-4	68	72	32
Positive-Tired	7	49	42	28	-9	33	42	12
Negative-Relaxed	6	42	36	24	-2	34	36	16

Converting between Scoring Methods (Reverse and Subtractive Scoring Methods)

Step 1: Calculating the Ranges

Calculating the range of a BMIS mood scale is fairly straightforward and involves finding the difference between the minimum and maximum values, as indicated in:

Equation 6.1

Equation to Calculate the Range

RNG = TS*max* – Ts*min* (Equation 6.1)

Where:

RNG: Range of a test scale
TSmin: The minimum mean for a test scale
TSmax: The maximum mean for a test scale

For example, the maximum value for the 4-point Positive-Tired mood scale using reverse scoring is 28; the minimum is 7. Therefore, using Equation 6.1, the range is 28 – 7 = 21. As a second example, the maximum of the 4-point Positive-Tired mood scale using subtractive scoring has a range of 21 = 18 – (-3).

Step 2: Calculating the Ranges' Midpoints and the Zero-Centered Values

In the second step, we need to center the scoring methods' ranges at zero, in other words, make zero the midpoint of the scoring methods' ranges of values, so we can successfully compare the different scoring methods. To do this we need to first find the original midpoints of the scoring methods' ranges. We can use Equations 6.2 or its variants Equations 6.3 and 6.4 (they are equivalent forms) to start:

Equations 6.2, 6.3 and 6.4

Equations to Calculate the Midpoint

$$HalfRng = RNG/2 \quad \text{(Equation 6.2)}$$

$$Midpnt = (TSmax - HalfRng) \quad \text{(Equation 6.3)}$$

or

$$Midpnt = (TSmin + HalfRngpt)$$

Or, more efficiently

$$MidPnt = (TSmin + TSmax)/2 \quad \text{(Equation 6.4)}$$

where:

HalfRng: Half the range of a test scale
TSmin: The minimum mean for a test scale
TSmax: The maximum mean for a test scale
MidPnt: The midpoint of the test scale range

After the original midpoints of the two scoring methods' ranges are calculated, the ranges can then be zero-centered using Equations 6.5 and 6.6. The result of the equations are the zero-centered values, which represent the values that would have been obtained if the original midpoints of the ranges were zero.

Equations 6.5 and 6.6

Zero-centering the ranges from the reverse and subtractive scoring methods

$$S_{SM}CV = (S_{SM}V - MidPnt_S) \quad \text{(Equation 6.5)}$$

$$R_{SM}CV = (R_{SM}V - MidPnt_R) \quad \text{(Equation 6.6)}$$

where:

$S_{SM}CV$: The zero-centered value from a subtractive scoring method
$R_{SM}CV$: The zero-centered value from a reverse scoring method
$MidPnt_S$: The midpoint of a range of values from a subtractive scoring method
$MidPnt_R$: The midpoint of a range of values from a reverse scoring method
$S_{SM}V$: The value from subtractive scoring
$R_{SM}V$: The value from reverse scoring

So if, for example, a researcher obtained a value for the 4-point reverse-scored Positive-Tired mood scale of 18, then the zero-centered value would be $R_{SM}CV = (R_{SM}V - MidPnt_R)$, or 10.5 = (18 – 7.5). Using Equation 6.5 and substituting in the midpoint for the scale of 17.5 (see Table 6.1, left), the zero-centered value would be $S_{SM}CV = (S_{SM}V - MidPnt_S)$, or 10.5 = 28 – 17.5.

Step 3: Comparing the Zero-Centered Values

As you can see from the example above, the zero-centered values from the reverse and subtractive scoring methods equal each other. This is because the ranges of the reverse and subtractive scoring methods are consistently the same (when the mood scale and response scale are the same). Consequently, when both the reverse and subtractive scoring methods' ranges are centered at zero, their zero-centered values will be equal. This makes it possible to algebraically set the reverse and subtractive zero-centered values equal to each other in order to directly compare the two values.

Equation 6.7

Comparing the Reverse and Subtractive Scoring Methods' Values for Scales of the Same Size (i.e., 4- or 7-point scales)

$$S_{SM}CV = R_{SM}CV \qquad \text{(Equation 6.7)}$$

or

$$(S_{SM}V - MidPnt_S) = (R_{SM}V - MidPnt_R)$$

where:

$S_{SM}CV$: The zero-centered value from a subtractive scoring method
$R_{SM}CV$: The zero-centered value from a reverse scoring method
$MidPnt_S$: The midpoint of a range of values from a subtractive scoring method
$MidPnt_R$: The midpoint of a range of values from a reverse scoring method
$S_{SM}V$: The value from subtractive scoring
$R_{SM}V$: The value from reverse scoring

Equation 6.7 shows that the zero-centered value from the subtractive scoring method is equal to that of the zero-centered reverse scoring method for scales of the same size (i.e., 4- or 7-point scales).

Step 4. Formalizing the Above in General Formulae

Now that the two zero-centered values are set equal to each other, Equation 6.7 can be rearranged to convert a given subtractive scoring method value into a reverse scoring method value (Equation 6.8), and a reverse scoring method value into a subtractive scoring method value (Equation 6.9).

Equations 6.8 and 6.9

Equations for Converting between Scoring Methods

$$R_{SM}V = S_{SM}CV + MidPnt_R \quad \text{(Equation 6.8)}$$

or

$$R_{SM}V = (S_{SM}V - MidPnt_S) + MidPnt_R$$

$$S_{SM}V = R_{SM}CV + MidPnt_S \quad \text{(Equation 6.9)}$$

or

$$S_{SM}V = (R_{SM}V - MidPnt_R) + MidPnt_S$$

where:

$S_{SM}CV$: The zero-centered value from a subtractive scoring method
$R_{SM}CV$: The zero-centered value from a reverse scoring method
$MidPnt_S$: The midpoint of a range of values from a subtractive scoring method
$MidPnt_R$: The midpoint of a range of values from a reverse scoring method
$S_{SM}V$: The value from subtractive scoring
$R_{SM}V$: The value from reverse scoring

To provide a first check of the formula, note that the midpoint of the 4-point reverse-scored Positive-Tired mood scale is 7.5 and its maximum is 18, whereas that of

the 4-point scale subtractive-scored midpoint is 17.5 and its maximum is 28 (values from Tables 6.1 and 6.2). If Equation 6.8 works, we should be able to convert a value from a subtractive scoring method to reverse scoring. Beginning with the maximum value on the 4-point Positive-Tired mood scale; that is, 28 from the subtractive-scored, we ought to get the maximum value from the reverse scoring. Using $R_{SM}V = (S_{SM}V - MidPnt_S) + MidPnt_R$ (Equation 6.8) we get $R_{SM}V = (28 - 17.5) + 7.5$, for an answer of 18, which is the maximum from reverse-scoring.

Converting between Response Scales (4-Point and 7-Point Response Scales)

The same basic principles apply when converting between response scales, with one exception: During Step 3, a further transformation must be undertaken before setting the two zero-centered values equal to each other. To better understand the necessity of this extra computation, you can see in Tables 6.1 and 6.2 that when comparing the ranges of a mood scale, the range of the 7-point scale is always double the range of the 4-point scale. For example, the Pleasant-Unpleasant 4-point range is 48 and the 7-point range is 96.

By subtracting 1 from both scales, it becomes clearer that the 7-point scale is simply double the 4-point scale (Table 6.3).

Table 6.3

Further Exploration of the Relations Between the 4- and 7-Point Scales

Original Form		Shifted to a Starting Point of Zero Subtracting 1 from Both Scales	
4 Point Scale	7 Point Scale	4 Point Scale	7 Point Scale
4	7	3	6
3.5	6	2.5	5
3	5	2	4
2.5	4	1.5	3
2	3	1	2
1.5	2	.5	1
1	1	0	0

Based on that observation, it is possible to make the two zero-centered response scale values (and subsequently the response scale ranges) equal to each other, by dividing the 7-point zero-centered value by 2 (Equation 6.10).

Equation 6.10.

Comparing the 4-Point and 7-Point Scales' Means

$$4PntCV = 7PntCV / 2 \qquad \text{(Equation 6.10)}$$

or

$$(4PntV - MidPnt_4) = (7PntV - MidPnt_7) / 2$$

where:

MidPnt$_4$: The midpoint of a range of values on a 4-point response scale
MidPnt$_7$: The midpoint of a range of values on a 7-point response scale
4PntV: The mean on the 4-point scale
7PntV: The mean on the 7-point scale
4PntCV: The zero-centered value on a 4-point response scale
7PntCV: The zero-centered value on a 7-point response scale

Due to the supplementary operation in Equation 6.10 (in relation to Equation 6.7), the equations used to convert a value between response scales are slightly different compared to the equations used to convert a value between scoring methods.

To provide a further check of the formula, note that the midpoint of the 4-point Pleasant-Unpleasant mood scale is 40 and its maximum is 64, whereas that of the 7-point scale midpoint is 64 and its maximum is 112 (values from Tables 6.1 and 6.2). If Equation 6.11 works, we should be able to convert one to the other. Beginning with a value at the very upper range of the 7-point scale; that is, 112 on the 7-point scale, we ought to get the maximum value on the 4-point scale. Using $4PntV = (7PntV – MidPnt_7) / 2) + MidPnt_4$ (Equation 6.11) we get $4PntV = ((112 – 64) / 2) + 40$, for an answer of 64, which is the maximum on the 4-point scale.

Equations 6.11 and 6.12

Equations for Converting a 7-Point to a 4-Point Scale Value and Vice Versa

$$4PntV = 7PntCV + MidPnt_4 \quad \text{(Equation 6.11)}$$

or

$$4PntV = (7PntV – MidPnt_7) / 2) + MidPnt_4$$

$$7PntV = 4PntCV + MidPnt_7 \quad \text{(Equation 6.12)}$$

or

$$7PntV = (4PntV - MidPnt_4) * 2) + MidPnt_7$$

where:

$MidPnt_4$: The midpoint of a range of values on a 4-point response scale
$MidPnt_7$: The midpoint of a range of values on a 7-point response scale
4PntV: The mean on the 4-point scale
7PntV: The mean on the 7-point scale
4PntCV: The zero-centered value on a 4-point response scale
7PntCV: The zero-centered value on a 7-point response scale

Converting between Response Scales and Scoring Methods

The formulae used to convert a value simultaneously across different response scales and scoring methods follow the above logic and are indicated in Equations 6.13 through 6.16.

Equations 6.13, 6.14, 6.15 and 6.16

Equations for Converting between Response Scales and Scoring Methods

$4RPntV = (7SPntCV / 2) + MidPnt_{4R}$ (Equation 6.13)

$4SPntV = (7RPntCV / 2) + MidPnt_{4S}$ (Equation 6.14)

$7RPntV = (4SPntCV * 2) + MidPnt_{7R}$ (Equation 6.15)

$7SPntV = (4RPntCV * 2) + MidPnt_{7S}$ (Equation 6.16)

where:

MidPnt$_{7S}$: The midpoint of a range of values for a 7-point response scale and subtractive scoring method
MidPnt$_{7R}$: The midpoint of a range of values for a 7-point response scale and reverse scoring method
MidPnt$_{4R}$: The midpoint of a range of values for a 4-point response scale reverse scoring method
MidPnt$_{4S}$: The midpoint of a range of values for a 4-point response scale subtractive scoring method
4RPntV: The value of the 4-point response scale and reverse scoring method
4SPntV: The value of the 4-point response scale and subtractive scoring method
7RPntV: The value of the 7-point response scale reverse scoring method
7SPntV: The value of the 7-point response scale and subtractive scoring method
4RPntCV: The zero-centered value on a 4-point response scale and reverse scoring method
7RPntCV: The zero-centered value on a 7-point response scale and reverse scoring method
4SPntCV: The zero-centered value on a 4-point response scale and subtractive scoring method
7SPntCV: The zero-centered value on a 7-point response scale and subtractive scoring method

So, for example, let's say we wish to convert from a minimum score of -2 on the Negative-Relaxed 7-point subtractive-scored mood scale of the BMIS, and see how it comes out on the 4-point reverse-scored version of the same scale. Using Equation 6.13, we get 4RPntV = ((-2 – 16) / 2) + 15 = 6, which is, indeed, the minimum value of the 4-point reverse-scored version of the Negative-Relaxed mood scale.

Part 7. Key Summary Equations and Tables

To summarize what has come before, this document has examined the four different implementations of the BMIS: reverse and subtractive scoring, crossed with 4- and 7-point response scales, and indicates the relations among the pairs of response scales and scoring approaches for a given scale. The present chapter revisits and summarizes some of the key points and comparisons.

The following assembles several of the key tables and equations that have come before.

Key Numerical Properties of the 4- and 7-Point BMIS Scales (Needed to Use the Key Equations Below)

Table 6.1 (Reprised)

Ranges and Midpoint for the four 4-Point BMIS Mood Scales Under Varied Conditions

	Reverse Scoring				Subtractive Scoring			
	Min	Max	Range	Mid point	Min	Max	Range	Mid point
Symbol	TS_{min}	TS_{max}	RNG	Midpnt	TS_{min}	TS_{max}	RNG	Midpnt
BMIS Mood Scales								
Pleasant-Unpleasant	16	64	48	40	-24	24	48	0
Arousal-Calm	12	48	36	30	2	38	36	20
Positive-Tired	7	28	21	17.5	-3	18	21	7.5
Negative-Relaxed	6	24	18	15	1	19	18	10

And the same values for the 7-Point BMIS scales are indicated in Table 6.2.

Table 6.2 (Reprised)

Ranges and Midpoint for the four 7-Point BMIS Mood Scales Under Varied Conditions

	Reverse Scoring				Subtractive Scoring			
	Min	Max	Range	Mid point	Min	Max	Range	Mid point
Symbol	TS_{min}	TS_{max}	RNG	Midpnt	TS_{min}	TS_{max}	RNG	Midpnt
BMIS Mood Scales								
Pleasant-Unpleasant	16	112	96	64	-48	48	96	0
Arousal-Calm	12	84	72	48	-4	68	72	32
Positive-Tired	7	49	42	28	-9	33	42	12
Negative-Relaxed	6	42	36	24	-2	34	36	16

The Equations for Converting Between Reverse and Subtractive Scoring Methods

Equations 6.8 and 6.9

Equations for Converting between Scoring Methods (Reprised)

$$R_{SM}V = S_{SM}CV + MidPnt_R \quad \text{(Equation 6.8)}$$

or

$$R_{SM}V = (S_{SM}V - MidPnt_S) + MidPnt_R$$

$$S_{SM}V = R_{SM}CV + MidPnt_S \quad \text{(Equation 6.9)}$$

or

$$S_{SM}V = (R_{SM}V - MidPnt_R) + MidPnt_S$$

where:

$S_{SM}CV$: The zero-centered value from a subtractive scoring method
$R_{SM}CV$: The zero-centered value from a reverse scoring method
$MidPnt_S$: The midpoint of a range of values from a subtractive scoring method
$MidPnt_R$: The midpoint of a range of values from a reverse scoring method
$S_{SM}V$: The value from subtractive scoring
$R_{SM}V$: The value from reverse scoring

The Equations for Converting Between 4- and 7-Point Scale Values

Equations 6.11 and 6.12

Equations for Converting a 7-Point to a 4-Point Scale Value and Vice Versa (Reprised)

$4PntV = 7PntCV + MidPnt_4$ (Equation 6.11)

or

$4PntV = (7PntV - MidPnt_7) / 2) + MidPnt_4$

$7PntV = 4PntCV + MidPnt_7$ (Equation 6.12)

or

$7PntV = (4PntV - MidPnt_4) * 2) + MidPnt_7$

where:

MidPnt$_4$: The midpoint of a range of values on a 4-point response scale
MidPnt$_7$: The midpoint of a range of values on a 7-point response scale
4PntV: The mean on the 4-point scale
7PntV: The mean on the 7-point scale
4PntCV: The zero-centered value on a 4-point response scale
7PntC*V*: The zero-centered value on a 7-point response scale

(Text continues on the next page.)

The Equations for Converting Between 4- and 7-Point Response Scale and Scoring Method Values

Equations 6.13, 6.14, 6.15 and 6.16

Equations for Converting between Response Scales and Scoring Methods (Reprised)

$4RPntV = (7SPntCV / 2) + MidPnt_{4R}$ (Equation 6.13)

$4SPntV = (7RPntCV / 2) + MidPnt_{4S}$ (Equation 6.14)

$7RPntV = (4SPntCV * 2) + MidPnt_{7R}$ (Equation 6.15)

$7SPntV = (4RPntCV * 2) + MidPnt_{7S}$ (Equation 6.16)

where:

$MidPnt_{7S}$: The midpoint of a range of values for a 7-point response scale and subtractive scoring method
$MidPnt_{7R}$: The midpoint of a range of values for a 7-point response scale and reverse scoring method
$MidPnt_{4R}$: The midpoint of a range of values for a 4-point response scale reverse scoring method
$MidPnt_{4S}$: The midpoint of a range of values for a 4-point response scale subtractive scoring method
4RPntV: The value of the 4-point response scale and reverse scoring method
4SPntV: The value of the 4-point response scale and subtractive scoring method
7RPntV: The value of the 7-point response scale reverse scoring method
7SPntV: The value of the 7-point response scale and subtractive scoring method
4RPntCV: The zero-centered value on a 4-point response scale and reverse scoring method
7RPntCV: The zero-centered value on a 7-point response scale and reverse scoring method
4SPntCV: The zero-centered value on a 4-point response scale and subtractive scoring method
7SPntCV: The zero-centered value on a 7-point response scale and subtractive scoring method

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