Rasch scalability of the somatosensory amplification scale: A mixture distribution approach

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A R T I C L E   I N F O

Article info

Objective: Somatosensory amplification refers to a person's tendency to experience somatic sensations as inappropriately intense and involves hypervigilance concerning bodily sensations. We applied the Somatosensory Amplification Scale (SSAS) in an Internet sample of young adults (N = 3031) to test whether the SSAS is Rasch scalable.

Methods: We applied mixture distribution extensions of the partial credit and rating scale models to identify possible subgroups that use the response set of the SSAS in different ways.

Results: A partial credit model, with two latent classes, showed a superior fit to all other models. Still, one of the SSAS items had to be removed because it showed severe underfit. Overall fit of the remaining items was acceptable, although the differentiation between at least two of the five item categories was questionable in both classes. Class 1 was characterized by a higher SSAS sum score, female gender, more somatic complaints, more anxiety, more psychosocial stress, and slightly higher depressiveness. Further exploratory analyses showed that the three mid categories of the SSAS can be collapsed without a large loss of information.

Conclusions: Our results show that a shortened version of the SSAS is Rasch scalable but also reveal that there is a lot of room for further improvements of the scale. Based on our results, Item 1 should be removed from the scale and a reduction of the number of response categories is probably warranted.

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Introduction

Somatosensory amplification refers to a person's tendency to experience somatic sensations as inappropriately intense and is characterized by hypervigilance concerning bodily symptoms, which are interpreted as possible signs of an illness [1]. This kind of exaggerated attention to bodily signs plays an important role in current models of somatoform disorders and functional somatic syndromes in general [2–4] and in hypochondriasis in particular [5,6]. Although there exists a considerable theoretical and empirical overlap [7,8], hypochondriasis is considered as a nosological entity distinct from other somatoform disorders [9]. Still, self-focused attention seems to play an important role in the whole group of somatoform disorders and is a central part of current models that try to explain their etiology and maintenance [2,10–13]. Somatosensory amplification does not seem to be related to real physical hypersensitivity, because participants who show a high tendency for somatosensory amplification do not perform better in a heartbeat detection task [14–17], nor are they more sensitive to tactile stimuli [18,19]. Brown et al. [19] even reported a negative correlation between somatosensory amplification and attention to the tactile modality in an experimental design. Marcus, Gurley, Marchi, and Bauer [20] reach the conclusion that cognitive misinterpretations of bodily sensations and not real physical hypersensitivity are the reason for the relationships between measures of health anxiety and somatosensory amplification. Up to now, we have only spoken about somatosensory amplification as a psychological construct and not about its measurement. These two aspects – the construct itself and its operationalization – are very closely related in the case of somatosensory amplification. The first questionnaire to measure somatosensory amplification consisted of five items [21,22] and was refined by Barsky et al. [1], who developed a 10-item version which showed good internal consistency (α = .82) and retest reliability (r = .79). This scale was called the Somatosensory Amplification Scale (SSAS) and has been extensively used in the domain of health anxiety and hypochondriasis [5]. Speckens, Spinholven, Sloekers, Bolk, and van Hemert [23] reported correlations between r = .20 and r = .27 for the Whiteley Index [24] and between r = .22 and r = .63 for the Illness Attitude Scales [25], depending on the particular kind of sample (outpatients, general population, etc.). One of the most recent instruments in the domain of health anxiety is the Multidimensional Inventory of Hypochondriacal Traits (MIHT), which also contains a perceptual scale that is intended to assess the “tendency to focus on bodily sensations” ([26], p. 6). Of the four scales, this one showed the highest correlation

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[37]. They mark those points of the latent trait continuum at which
parameters are often referred to as threshold parameters and are asso-
ciated with the transition from one response category to the next higher
one [37]. They mark those points of the latent trait continuum at which
the probability of a response in two adjacent categories (e.g., not bo-
thered at all, bothered a little) is equal (p = .50). A restricted version (i.e.,
a sub-model of the PCM is the rating scale model (RSM) by Andrich
[38], which assumes that the distances between those threshold param-
eters are the same across all items. This restriction implies that the
response set is used similarly across all items, but still allows each
item to exhibit a different overall difficulty.

Compared with CTT, two popular advantages of IRT models are item
parameter invariance regarding the examinee group and independency
of ability scores and test difficulty [39,40]. However, the most important
advantage of IRT over CTT is probably that it provides strict tests for its
assumptions. Some important aspects of the measurement model are
even not described at all in CTT as the type of the relationship between
ability and answering probability (i.e., the item characteristic curve in
IRT models). Other aspects like unidimensionality are not mentioned
in the original CTT framework but some statistics like, e.g., the item-
test correlation do not make sense without this assumption [28,41].
The ordinary practice to create a sum score of polytomous items for
CTT-based questionnaires implies that the respondents perceive the
response set as ordered along the trait continuum. By means of the
application of the PCM and RSM, we can examine if this assumption is
met and we are able to suggest solutions (e.g., collapsing of categories)
in case it is violated. All the Rasch models mentioned above have been
extended to mixture distribution models [42,43]. In a mixture distribu-
tion model, one assumes that there exist one or more latent subpopu-
lations (i.e., classes) in which the Rasch model (or its extensions) holds,
but with different model parameters [42]. This means that the item
and ability parameters are calculated separately for each latent class.
Thus, the mixture distribution models can be seen as a combination of
latent class analysis and the Rasch model [44]. One common reason
which makes the assumption of more than one latent class necessary is
a different use of the response set in two or more latent classes
[31,45]. Members of one class could be characterized by the tendency
to avoid extreme ratings at the end of the Likert-scale whereas the
members of the other class do not show such a behavior. This could
mean that the members of the two classes perceive and use the response
set in a different way.

Mixture distribution models are closely related to what is called
differential item functioning (DIF) and plays an important role in the
application of IRT [46,47]. The basic idea behind the DIF approach [47]
is that the items of a test may function differently across subgroups of
the target population. One example could be that the relative item difficulties
are not the same for both genders (e.g., Item 1 is the easiest item within
the male group but only the second easiest within the female group).
The traditional way to detect DIF is to divide the sample into two distinct
groups which are expected to show DIF and to calculate the IRT model in
both groups separately [48]. Afterwards, one examines if the item param-
eters and the slope of the Item Characteristic Curves are equal across both
examinee groups [49,50]. Unfortunately, this approach only functions
well when the relationship between DIF and the group variable is very
high [51,52]. Various studies have shown that this is rarely the case in
applied research with qualitative group variables like gender, age, and
race [53]. Many authors see the application of mixture distribution tech-
niques to identify DIF as the method of choice [44,46,51,52,54].

In this article, we only focus on the Rasch model and its extensions
to polytomous items and multiple classes. It is important to keep in mind
that for less restrictive IRT models such as the two parameter model
(or the three parameter model which involves additional guessing
parameters) according to Birnbaum [55] the sum score is not a suffi-
cient indicator of the performance of a participant. This makes their
application in applied contexts problematic [56,57]. Some authors like,
e.g., Scheilblechner ([56], p. 181) went so far to call those models
“pseudo-Rasch models” and conclude that they are not really suitable
for practical test applications.

We have pointed out that the SSAS is a widespread instrument
and yet, to our knowledge, no study has examined its measurement
characteristics by means of an IRT approach. The common use of
SSAS sum scores implies that the categories of its items are perceived
as ordered along the latent continuum. Moreover, it is desirable that
the postulate of local independence holds, which means that the
answer to an item only depends on a person’s trait strength and the
item difficulty, and not on, e.g., the answer to a preceding item
[48]. If the PCM or the RSM offers a good fit to the data, one can
assume that the SSAS fulfills these characteristics, which in turn in-
creases the value of the questionnaire for future applications. Com-
parison of the results obtained with the PCM and RSM can help to
identify whether the participants really use the response set across
all items in a consistent way. Through the application of mixture distri-
bution models, it becomes possible to search for subpopulations
within our sample that are characterized by a different use of the
SSAS, which could also have important implications for future appli-
cations of this instrument.

The SSAS in its original form (i.e., 10 items, 5-point Likert scale)
has been applied to various domains of clinical psychology over
many years. Therefore, our first aim is to examine the measurement
characteristics of the SSAS in its original 10-item form by means of
the mixture distribution extensions of the PCM and the RSM. When
necessary, we will improve the measurement characteristics of the
SSAS by the exclusion of unsuitable items and the collapsing of
item categories. We hypothesize that the SSAS is Rasch scalable by
means of the PCM because this model is more flexible than the
RSM (i.e., perceived distances between item categories may differ
across items) and the SSAS was not developed to fit the more restric-
tive RSM. Moreover, we are going to examine the measurement
characteristics of the SSAS in a rather homogenous internet sample
(i.e., compared to a population representative sample). Therefore,
we do not expect that more than one latent class is necessary to pro-
vide a good fit of the model to the data.
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