

## Developing and validating the Japanese version of Dimensional Apathy Scale (J-DAS)

Short running title: Japanese version of DAS

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Text

Apathy is defined as a syndrome of primary lack of motivation,<sup>1</sup> commonly observed in neurological and psychiatric disorders,<sup>2</sup> as well as in the healthy population.<sup>3</sup> In Japan, apathy has been defined and extensively researched. Clusters of patients who exhibit a loss of motivation can be separated from vascular depression with research focusing on apathy as a construct.<sup>4</sup> A neurobiological multidimensionality of apathy was conceptualized by Levy & Dubois,<sup>2</sup> where there is a “quantitative reduction of voluntary, goal-directed behaviors.” and multidimensional apathy is recognized in the diagnostic criteria for apathy.<sup>5</sup> The Dimensional Apathy Scale (DAS) was originally developed in English<sup>6</sup> that quantifies apathy subtypes with reference to the Levy and Dubois model<sup>2</sup>, which are related to difference brain region and networks. The DAS classified apathy into Executive apathy as a lack of motivation for planning, organization or attention, Emotional apathy as an emotional flatness, blunting, and indifference, and Initiation apathy as a lack of motivation for self-generation of thoughts or actions. The DAS has been translated and used in to various languages such as Italian.<sup>7</sup> The aim of the present study was to translate and validate a Japanese version of DAS (J-DAS) for assessing apathy subtypes.

The original DAS was firstly translated into Japanese by Japanese collaborators (TK, KO, and SY), which then was back-translated by third party (Text Edit.com: [www.text-edit.com/english-page/](http://www.text-edit.com/english-page/)). The translated version was checked and discussed with a coauthor (RR), one of the authors of original DAS, and further revised. This procedure was iteratively completed until agreement was reached among all authors. The J-DAS can be found in Table S1. We conducted an online survey to validate the J-DAS against the Apathy Scale (AS-14)<sup>8</sup> which is a 14-item traditional “one-dimensional” apathy scale, and Beck’s Depression Inventory II (BDI-II)<sup>9</sup>, a 21-item questionnaire for assessing depression.

We analyzed 496 participants (mean age = 44.8 years; SD = 13.8; 250 female/246 male; mean years of education: 14.6, SD = 2.3) who gave informed consent and whose anonymity has been preserved (see supplemental information). They scored a mean of 14.6 (SD = 12.0) on the BDI-II and a mean of 17.5 (SD = 7.0) for the AS-14. On the DAS total the scored a mean of 35.1 (SD = 6.8), with a mean of 7.9 (SD = 4.1) for Executive, 12.0 (2.7) for Emotional and 15.1 (4.3) for (Behavioral and Cognitive) Initiation subscales. All J-DAS subscales and total score were significantly positively correlated (weak to strong) with the apathy measure (AS-14) and the Emotional component of J-DAS was not significantly correlated with the depression measure (BDI-II) while Executive and Initiation components were significantly positively correlated

(moderate and weak, respectively) with the depression measure (Table S2). The Cronbach's standardized alpha for the J-DAS was 0.69. There were no floor and ceiling effects for any of the questionnaire measures.

An explanatory factor analysis (EFA) with Varimax (Orthogonal) rotation was used to determine the substructure of the DAS scale, due to factors being uncorrelated (Table 1). Horn's parallel analysis indicated that 3 factors should be extracted. The mean Measure of Sample Adequacy (MSA) showed the sample to be factorable (0.88), further supported by a significant Bartlett's test for Sphericity ( $p < .001$ ). The 3-factor solution cumulatively accounted for 38% of the total variance and the factors were subsequently labelled based on the themes of the items loading onto them. Overall 87.5% of items saliently loaded onto the original DAS. Although the mapping to Emotional apathy seems lack of consistency, over half of the items that mapped onto the Emotional apathy subscale (D5 and D7) were those that were selected for the brief-DAS, a short clinical version of the DAS<sup>10</sup>. Moreover, analysis between DAS subscales and EFA derived subscores showed strong positive correlations between corresponding DAS-Factor subscores (Table S2).

As with the original DAS,<sup>6</sup> the J-DAS had a three-factor structure mapping on to the Executive, Emotional and Initiation apathy subtypes. It also has good internal consistency and reliability, in addition to good convergent validity against a one-dimensional apathy measure (AS-14) and good divergent validity against a gold-standard depression measure (BDI-II). Moreover, the AS-14 was significantly correlated with all subscales of J-DAS, supporting the validity of the multidimensional apathy assessment while the inter-subscale correlations showed the nature of multidimensionality of J-DAS as that the three subscales showed only weak correlation among them,  $r = 0.286$  at most (Emotional-Initiation). The J-DAS is the first valid and reliable tool for assessing multidimensional apathy in Japanese. It can be used for assessing the general trait-motivation of healthy individuals in daily life. Further research should aim to explore the apathy subtype profiles using the J-DAS in neurodegenerative, neurological and psychiatric conditions, which would extend the understanding of apathy transculturally.

#### **Disclosure Statement**

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**Supporting information**

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**Table 1.** Orthogonal rotation EFA of self-rated DAS items and factor labels of Initiation, Executive and Emotional, with mapping on to original DAS subtypes (N = 496)

Item No. – original subscale	ML2 (Executive)	ML1 (Initiation)	ML3 (Emotional)
D11-Ex	<b>0.68</b>	0.22	0.00
D23-Ex	<b>0.66</b>	0.01	-0.16
D19-Ex	<b>0.66</b>	0.03	-0.13
D21-Ex	<b>0.64</b>	-0.14	-0.02
D1-Ex	<b>0.63</b>	0.08	-0.22
D12-Em	<b>0.61</b>	-0.03	0.05
D17-Ex	<b>0.55</b>	-0.07	-0.08
D24-Em	<b>0.55</b>	-0.02	0.27
D6-Ex	<b>0.51</b>	-0.19	-0.21
D22-BCI	0.05	<b>0.75</b>	0.08
D13-BCI	0.02	<b>0.73</b>	0.13
D14-BCI	-0.03	<b>0.70</b>	0.14
D16-BCI	-0.07	<b>0.62</b>	-0.08
D4-BCI	-0.15	<b>0.57</b>	0.26
D10-Ex	0.16	<b>0.53</b>	0.11
D8-BCI	-0.09	<b>0.50</b>	0.29
D18-BCI	-0.06	<b>0.47</b>	0.10
D2-BCI	-0.01	<b>0.39</b>	<b>0.31</b>
D7-Em	<b>-0.33</b>	0.18	<b>0.53</b>
D5-Em	-0.19	0.27	<b>0.45</b>
D15-Em	0.19	<b>-0.52</b>	<b>0.30</b>
D3-Em	-0.24	0.29	0.27
D9-Em	<b>-0.41</b>	0.09	0.17
D20-Em	<b>-0.43</b>	0.21	0.25
Proportionate Variance	0.17	0.16	0.05
Cumulative variance	0.17	0.33	0.38
% mapping to original DAS subtypes (loadings $\geq 0.3$ )	87.5	100	37.5

Note: Loadings in grey those most applicable to each factor. Loadings in bold are considered salient ( $> 0.3$ ). Ex= Executive, Em= Emotional, BCI= Behavioral and Cognitive Initiation.