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Title: Psychometric Properties and Associations Between Subscales of a Study Approach Measure

Short title: Approaches and Study Skills Inventory for Students

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Abstract

The purpose of the current study was to (i) confirm the factor structure of the Approaches and Study Skills Inventory for Students **(ASSIST) in the current sample of undergraduate occupational therapy students, and (ii) to explore the pattern of associations between the 13 ASSIST subscales. Occupational therapy students (n= 171) across Norway completed the ASSIST. A three-factor structure was confirmed.** Several positive associations were found between the deep and strategic approach subscales, whereas several surface approach subscales were negatively associated with the deep and strategic approach subscales. In conclusion, the study showed that the Norwegian ASSIST has a well-functioning three-factor structure in line with its theoretical **underpinnings, and it can therefore readily be adopted as a study process measure in Norwegian occupational therapy education programs. In view of the associations between subscales, there is** support for a higher-order concept of 'productive' study approaches that encompasses both deep and strategic behaviors. The analysis of associations also suggests that students demonstrating unproductive study behaviors may need guidance and intervention that extends beyond the first detected problematic behavior.

Keywords: approaches to studying; factor analysis, higher education; learning; occupational therapy

Introduction

The education of occupational therapy students, as with all healthcare practitioners, is carefully structured and monitored for adherence to standards to protect future clients and insure quality of clinical practice. **The World Federation of Occupational Therapists (World Federation of Occupational Therapists [WFOT], 2016),** has established standards that require students to acquire foundational knowledge in multiple areas, including sciences (such as anatomy, physiology, disease processes) and social sciences (such as mental health and wellbeing). In Norway, current regulations have established learning outcomes for occupational therapy candidates in the areas of knowledge, skills and general competence (Ministry of Education and Research, 2019). Students must then learn to apply this knowledge base to meet the unique needs of individuals that seek their services for a variety of occupational concerns. Furthermore, students must be able to demonstrate this knowledge and application to successfully pass examinations before they are allowed practice as occupational therapists (WFOT, 2016). Having both traditional pedagogical and knowledge application standards within rigorous curricula, students' approaches to learning become an important area of study.

The exploration and assessment of teaching approaches in occupational therapy programs has increased recently as occupational therapy education must go beyond teaching technical skills to foster the development of creative problem solving, critical reasoning and the use of scholarly evidence to solve complex clinical problems (WFOT, 2016). However, teaching represents only one facet of the academic process. McKeachie (1974) highlighted the historical lack of focus on *learner* perspectives, noting that individual differences make understanding the academic process frustrating, but also represent an area of potential impact on the learning process. Marton & Säljö's (1976) work identified two apparently opposing learning approaches, deep (critical thinking and comparing of ideas) and surface (syllabus

bound, rote learning). Research on the impact of personal characteristics on learning increased with elaboration on the deep and surface approaches to learning. After multiple iterations of testing these theoretical categories, a third approach of strategic (*achieving orientation*) was added (Entwistle, 2018).

Students' approaches to learning have been found to correlate with academic performance in a wide range of studies from diverse fields (Diseth & Martinsen, 2003; May, Chung, Elliot, & Fisher, 2012; Richardson, Abraham, & Bond, 2012; Ward, 2011a, 2011b), including occupational therapy (Bonsaksen, Brown, Lim, & Fong, 2017; Bonsaksen, Brown, Lim, Fong, & Småstuen, 2020). Students employing deep and/or strategic study approaches tend to perform better, compared to students largely employing surface approaches to studying. **This knowledge may be of importance to occupational therapy education programs as they seek to admit students who can succeed, and to teach them the complex scope of occupational therapy practice. However the data available on occupational therapy student approaches to learning has been only recently emerging. A greater understanding of students' approaches to learning may provide insights for educators to assist students in their uptake and application of study materials, and to prepare them for self-directed study methods commonly applied in health education.**

The need to investigate measurement properties

Recent research into occupational therapy education has shown positive student outcomes associated with adopting both deep and strategic approaches to studying. For example, students with higher scores on 'seeking meaning' (deep approach subscale) and 'achievement' (strategic approach subscale) had higher grade point average, compared to their counterparts with lower scores on these subscales (Bonsaksen et al., 2017). However, a premise for trusting these and similar results is that the instruments used to assess the concepts are psychometrically sound. Studies of one the most frequently used study approach

assessments, the Approaches and Study Skills Inventory for Students (ASSIST; Tait, Entwistle, & McCune, 1998), have largely confirmed a three-factor structure with subscales for the most part loading on the main scales in line with theory (e.g., Entwistle, McCune & Tait, 2013; Entwistle, Tait, & McCune, 2000; Richardson, 2005). Nonetheless, scale validity and reliability of the ASSIST has been found to vary between samples and contexts (Bonsaksen, Småstuen, et al., 2019), confirming the need to establish and report the measurement properties of research instruments when used in new samples and cultural contexts (Downing & Haladyna, 2006; Streiner & Norman, 2008).

Moreover, recent studies have suggested that subscales belonging to different factors may correlate systematically. For example, Gramstad and colleagues (2020) proposed a relationship between lower 'achievement' (part of the strategic approach scale) and higher 'lack of purpose' (part of the surface approach scale) in their interpretation of the differences found between the six education programs they investigated. Papinczac's (2009) cluster-analytic approach also suggested that a deeper understanding of the associations between different aspects of the deep, strategic and surface study approaches **is warranted, as it can potentially lead to enhanced support of students throughout the learning process. Thus, measurement properties of the ASSIST need to be confirmed for the current sample. The examination of associations between its subscales may lead to new insights into the patterns of students' study behaviors that may allow for student-centered intervention.**

Study aims

The aims of the current study were to (i) confirm the factor structure of the ASSIST in the current sample of undergraduate occupational therapy students, (ii) to explore the pattern of associations between the 13 ASSIST subscales.

Methods

Design and setting

The study is a sub-study of a larger study of occupational therapy students. The research project as a whole is a longitudinal study of study approaches (Gramstad et al., 2020; Mørk et al., 2020) and the perceived learning environment (Bonsaksen, Gramstad, Mørk & Johnson, 2019; Thordardottir et al., 2020; Thygesen et al., 2020) among undergraduate occupational therapy students in Norway. One student cohort was followed-up with one annual survey in each of their three study years. This study had a cross-sectional design, employing data from first-year students who self-selected to participate in the study (convenience sampling). The data were collected between December 2017 and March 2018.

Participants and response rate

Occupational therapy students were recruited for inclusion at each of the six higher education institutions in Norway that provide occupational therapy education. From these programs 305 students **were eligible participants, and of these 187 students participated (response rate 61.3 %). Responses from participants with missing values on employed variables were removed.** By this procedure, 16 students were removed and 171 were retained for analysis. Among the 171 participants who were included in the analysis, there were 36 (21.1 %) men and 135 (78.9 %) women. The mean age in the sample was 22.7 years (SD = 4.4 years).

Measurement

Sociodemographic variables

Age (in years) was registered as a continuous variable, while gender was registered as a categorical variable (male = 0, female = 1).

Approaches to studying

The students' approaches to studying were assessed from the students' scores on the Approaches and Study Skills Inventory for Students (ASSIST; Tait et al., 1998). The ASSIST is frequently used with students in higher education and can serve to identify students experiencing problems with studying. In the current study the authors used the Norwegian version of the 52-item ASSIST questionnaire, as validated previously (Diseth, 2001). Theoretically and as established from prior psychometric studies (Bonsaksen, Småstuen, et al., 2019; Byrne, Flood, & Willis, 2004; Entwistle et al., 2000; Reid, Duvall, & Evans, 2005), the ASSIST items are organized into three main factors (the *deep*, *strategic*, and *surface* approaches). The deep approach consists of four subscales (seeking meaning, relating ideas, use of evidence, and interest in ideas); the strategic approach consists of five subscales (organized study, time management, alertness to assessment demands, achieving, and monitoring effectiveness); while the surface approach consists of four subscales (lack of purpose, unrelated memorizing, syllabus-bound, and fear of failure). Some ambiguity exists regarding the 'monitoring effectiveness' subscale, with some researchers suggesting this subscale is more strongly related to the deep approach (Entwistle, McCune & Tait, 2013). The Norwegian language ASSIST, examined with factor analysis (Bonsaksen, Småstuen, et al., 2019) and structural equation modelling (Diseth, 2001), have found the same three latent factors (deep, strategic, and surface approaches).

Data analysis

The sample was described with descriptive statistics; means and standard deviations for continuous variables and frequencies and percentages for categorical variables. Principal Components Analysis (PCA) was performed to assess latent factors in the ASSIST. In line with previous studies (Bonsaksen, Småstuen, et al., 2019; Byrne et al., 2004; Diseth, 2001; Valadas, Goncalves, & Faísca, 2010), the authors treated the 13 subscales as separate items in the analysis. The Kaiser-Meyer-Olkin (KMO) measure was used to indicate whether the data

set was eligible for factorization. KMO measures should exceed 0.60 in order to proceed with factor analysis (Kaiser, 1974). Bartlett's Test of Sphericity (Bartlett, 1954) was used to assess whether the variables' correlations were significantly different from zero. Expecting substantial correlations between the scale items, the authors used the Direct Oblimin rotation method. Factor extraction was determined by inspecting the scree-plots, by assessing the Eigenvalue (λ) estimates, and by assessing the proportion of data variance explained by the factors. Factors with $\lambda > 1$ and/or factors explaining more than 10 % the variables' variance proportions were retained. In addition, the authors employed Parallel Analysis (Horn, 1965) in order not to overestimate the number of extracted factors (Zwick & Velicer, 1986). The Parallel Analysis suggests that factors should be retained only if the actual λ exceeds the randomly generated λ of the corresponding factor in a random dataset, using the same number of variables and respondents.

Statistical measures reported from the PCA include communalities, indicating the variance proportion of each variable explained by the factors together, and factor loadings, which are estimates of the association between a given variable and the extracted factors. To obtain a clearer view of the pattern, the factor loadings from the structure matrix were inspected, and loadings > 0.40 were considered high. Internal consistency was examined with Cronbach's α, and Cronbach's α coefficients exceeding 0.70 were considered satisfactory (Ponterotto & Ruckdeschel, 2007).

Finally, the authors investigated the strength of the bivariate associations between pairs of ASSIST subscales by Pearson's correlation coefficient *r*. The strength of associations (effect sizes) were interpreted according to Cohen (1992); i.e., $r = 0.10$ indicates a small effect, $r = 0.30$ a moderate effect, and $r = 0.50$ a large effect. Statistical significance was set at 0.05 and all tests were two-tailed.

Research ethics

Approval for collecting, storing and utilizing the data was granted on October 12, 2017 by the Norwegian Center for Research Data (project no. 55875). All participants provided written informed consent to participate**. A project representative (author) at each of the involved education programs provided information about the study to participants, in both verbal and in written formats.** The students were informed that completion of the questionnaires was voluntary, that their responses would be treated in confidence, and that there would be no negative consequences from opting not to participate in the study.

Results

Factor structure of the ASSIST scales

As the first step in the exploratory PCA, the items' communalities ranged between 0.43 (seeking meaning) and 0.79 (alertness to assessment demands). Four factors had Eigenvalues > 1, explaining 26.6 %, 14.9 %, 13.8 %, and 8.0 % of the data variance, respectively. When controlling the factor extraction with the Parallel Analysis, the authors found a randomly generated $\lambda = 1.77$ for Factor 4, which was higher than the actual λ (1.05) found for the fourth factor in the PCA. Thus, the Parallel Analysis and the low proportion explained variance related to Factor 4 suggested that no more than three factors should be extracted.

Second, a confirmatory PCA with three factors to be extracted was conducted. The results are displayed in Table 1, while Figure 1 displays the scree plot of extractable factors against their corresponding Eigenvalues. The KMO value was 0.76, and Bartlett's test of sphericity was statistically significant ($p < 0.001$). The items' communalities ranged between 0.41 (seeking meaning) and 0.74 (achieving). The three extracted factors accounted for a total of 55.3 % of the data variance. The structure matrix showed that all items loaded

substantially (i.e., > 0.40) on one of the three factors, with only one item cross-loading. The one cross-loading item was 'monitoring effectiveness', which loaded 0.65 on Factor 1 and 0.43 on Factor 2.

[Table 1 and Figure 1 about here]

Five of the items loaded most strongly on Factor 1. These items were the subscales organized study, time management, achieving, monitoring effectiveness, and alertness to assessment demands. Four items loaded on Factor 2. These items were the subscales relating ideas, use of evidence, interest in ideas, and seeking meaning. Similarly, four items loaded on Factor 3. These items were the subscales fear of failure, lack of purpose, unrelated memorizing, and syllabus-bound. Factors 1 and 2 were positively correlated (0.20), whereas the correlations between Factors 1 and 3 (-0.10) and between Factor 2 and 3 were negative (-0.06).

Associations between subscales

The correlation matrix with all bivariate associations between the ASSIST subscales are shown in Table 2. All of the deep approach subscales (seeking meaning, relating ideas, use of evidence and interest in ideas) were positively and significantly correlated with each other (*r* ranging between 0.30 and 0.50). Similarly, all of the strategic approach subscales (organized study, time management, alertness to assessment demands, achieving, and monitoring effectiveness) were positively and significantly correlated with each other (*r* ranging between 0.20 and 0.69), as were all of the surface approach subscales (lack of purpose, unrelated memorizing, syllabus-bound, and fear of failure) with *r* ranging between 0.25 and 0.35.

[Table 2 about here]

In addition, there were several positive and significant associations between the deep approach subscales and the strategic approach subscales. The strategic subscale 'monitoring effectiveness' was significantly related to all of the deep approach subscales (*r* ranging between 0.17 [seeking meaning] and 0.33 [use of evidence]). Further, there were several negative and significant associations between the surface approach subscales and subscales belonging to the two other study approaches. The subscales 'lack of purpose' and 'syllabus-bound' showed the same pattern of being negatively associated with the strategic approach subscales 'organized study', 'time management' and 'achieving'. We also noted that three surface approach subscales ('lack of purpose', unrelated memorizing' and 'fear of failure') were negatively and significantly associated with the deep approach subscale 'interest in ideas'.

Discussion

Measurement properties of the ASSIST

This first aim of this study was to confirm the factor structure of the ASSIST in a sample of undergraduate occupational therapy students using the 13 subscales as distinct items in the analysis. The importance of carrying out item analyses with specific groups is suggested by authors on scale development (Downing & Haladyna, 2006; Streiner & Norman, 2008), including the authors of the ASSIST (Entwistle, McCune, & Tait, 2013). In this study the cogent groupings of the subscales to form the latent approach constructs (the deep, strategic and surface approaches), supported the inventory's three-factor model. This is consistent with multiple prior studies (e.g., Bonsaksen, Småstuen, et al., 2019; Entwistle et al., 2000; Richardson, 2005). One subscale, 'monitoring effectiveness', was noted to load on

Factor 1 and 2, representing both strategic and deep approaches. Cross-loadings related to some of the scales are also consistent with prior findings (Byrne et al., 2004; Diseth, 2001; Entwistle et al., 2000), and should therefore be expected and tolerated to a certain extent. In summary, the ASSIST was found to have a sound three-factor structure, much in line with previous studies of the measure, and may therefore be used with confidence.

Pattern of associations between subscales

The second aim of the study was to explore the pattern of associations between all 13 ASSIST subscales. Within each of the main scales (the deep, strategic and surface approaches), all subscales were positively and significantly correlated with each other (see Table 2), as would be expected from theory and from the factor analysis results. Likewise, the strategic approach subscale 'monitoring effectiveness' was positively associated with the deep approach subscales. This is also in line with recent updates from the instrument developers regarding this subscale and its relationship to the main scales (Entwistle, McCune & Tait, 2013). Similar results have been found by others, such as Reid and colleagues (2012), who investigated undergraduate medical students and found they frequently used both strategic and deep approaches, which the researchers attributed to the *teaching* approach (designed to evoke deep learning and meaning making) and the ethos of the school. Others (Carrick, 2010; May et al., 2012) noted an increased use of the combined approaches in clinical environments (i.e., when there were higher interpersonal demands), but higher use of surface approaches when direct skills were being tested, as in more traditional testing situations. This supports the idea that students are aware of the unique expectations in each academic environment and of how they can maximize performance in each of them. As learning inventories by their nature seek to measure latent constructs, comprised of multiple features, students are not expected to adopt only one approach at all times (Entwistle, 2018).

This would be an ineffective response to the varying demands of academic and clinical education (Dinsmore & Alexander, 2012).

Some students may identify an overarching paradigm in their education and approach learning and studying based on this. Smith and co-workers' (2010) study of pharmacy students found that those in this clinical field of study showed a preference for practical knowledge over (deep) meaning seeking, although they utilized more deep approaches later in their education. Occupational therapy curricula span a wide variety of topics such as basic sciences, splinting techniques, occupational theory, and mental health. Educators teaching these diverse topics may reinforce different forms of learning, such as rote memorization or deep meaning seeking among students. Since students must pass all course exams before they can practice, monitoring the effectiveness of their studying seems a logical, adaptive response to the varied expectations in these classes. Furthermore WFOT standards for occupational therapy education require that students develop critical thinking skills, effective use evidence-based practice, and a posture as lifelong learners (aspects of the deep approach). Thus, these elements are reinforced in schools through a variety of methods (Ministry of Education and Research, 2019; WFOT, 2016). The competing demands of thinking critically and gaining deeper understanding, while also monitoring performance effectiveness, may explain the associations between the 'monitoring effectiveness' subscale and the deep approach subscales found in the students in this study (Table 2).

In addition, several of the surface approach subscales were negatively associated with subscales belonging to the deep and strategic approaches to learning. Results of studies that use the ASSIST make clear that the synthesis of deep and strategic learning approaches represents overall behavioral choices and attitudes that may transcend existing academic challenges, to lead to academic success. The behaviors (such as meaning making, monitoring success) appear incompatible with surface approaches, such as rote memorization and

studying without purpose. However, surface approaches can serve a temporary purpose of absorbing knowledge until the typically deep learner has adequate time or cognitive bandwidth to process it fully, as suggested by Ryan and Louie (2007). It stands to reason that a learner who strategizes and monitors learning might benefit from using rote memorization, if they judge this to be the most effective response to a given situation.

This study showed moderate, inverse relationships between strategic organization, time management, and achievement orientation approaches and lack of purpose and syllabus-bound behaviors. Likewise, higher interest in ideas was inversely related to lack of purpose, unrelated memorizing, and fear of failure. It could be argued that students with the end goal of practicing occupational therapy might find purpose even in subjects that were less stimulating but necessary for them to complete their education and begin practicing. This resonates with the concept of self-regulated learning. In early work, Ertmer and Newby (1996) outlined distinct skills of self-regulated learning, including planning, monitoring, evaluating, and reflecting on one's learning. These constructs are captured in items on both the strategic and deep approach scales, again evidencing the logic of their combined use in many students (Entwistle, McCune, &Tait, 2013). The use of these skills allow self-regulated learners to find meaning in activities that they might naturally be less interested in or feel are unrelated to their personal goals (Wilson & Cole, 1991).

As with strategic and deep approaches, studies have shown that the use of self-regulated learning strategies is associated with academic success (Wolters & Hussain, 2015). Self-regulated learning is particularly effective in clinical education (Woods, Mylopoulos, & Brydges, 2011). Moreover, students can learn to use self-regulated learning strategies (Wolters & Hussain, 2015). Thus, targeting student motivation and developing their skills of self-regulation may be effective methods of increasing student engagement in coursework and their use of strategic and deep skills, such as monitoring learning and success and

constructing meaning from connecting ideas and concepts (Wolters & Hussain, 2015). This resonates with occupational therapy literature on meaning and motivation. Motivation prompts individuals to engage in activities they consider meaningful and contributes to an individual's sense of agency, control, and movement towards personal goals (Eakman, Carlson, & Clark, 2010).

Implications and future research

First, the factor analysis performed in this study once more confirmed the construct validity of the deep, strategic and surface ASSIST scales, lending credibility to studies using these scales to assess students' approaches to studying. **Thus, the ASSIST can therefore readily be adopted as a study process measure in Norwegian occupational therapy education programs.**

Second, the study found several positive associations between the subscales derived from the deep and strategic approach scales, lending support to the notion of 'productive study approaches' as a higher-order concept encompassing both deep and strategic behaviours**. Thus, in cases where simplification is called for, it may be useful to speak of productive (i.e., deep and strategic) and unproductive (i.e., surface) approaches to studying.**

Third, the study found evidence (although not a consistent pattern) of inverse associations between the surface approach subscales, and the deep and strategic approach subscales. While educators may not be able to make assumptions from the data about interrelated attitudes and behaviours they may find similar patterns, For example, students who demonstrate an unwillingness to explore content beyond the extent of their syllabus may need support to see purpose in learning and assistance in being more strategic in their study efforts. **Students demonstrating surface approach behaviours may need guidance to see**

the value of and connections between academic content areas and their role as future practitioners, the presumed long-term goal.

In view of evidence that teaching approaches can impact study approaches, and that relating ideas and making meaning (deep learning concepts) can increase over time, educators can attempt to impact learning by focusing on and cultivating higher-level skills in classes. The onus, however, may be on educators to help students shift from surface approaches by means of well-planned lessons that synthesize content with presumed student goals. This can be done through scaffolding of content and the use of testing formats that evoke deeper learning, application and critical thinking**. In these ways, educators can continue to challenge learners who naturally seek meaning and connections, and perhaps elicit newfound meaning and motivation for content if they can make clear connections to their relevance to future occupational therapy practice.**

The identification of student approaches to learning in this study reflects initial inquiries into an expansive area of research. Future studies could compare approaches to studying and learning at the graduate level, explore potential changes to approaches over time, and examine the efficacy of interventions aimed to influence student productive behaviours/approaches to enhance their academic success.

Study strengths and limitations

According to Stevens (1996), multivariate analyses should allow for 15 participants per included variable. In the current study, responses on 13 variables (number of ASSIST subscales) from 171 participants were analyzed, resulting in 13 participants per included variable. Thus, the sample size was in the lower range. The study is also limited in its use of students from only one country and from only one line of professional education. However, the sample was composed of students from six different higher education institutions, adding to the variety of experiences in the sample and to the authors' ability to generalize the results

to the larger population of undergraduate occupational therapy students. While the investigation of associations between the ASSIST subscales across the three main approaches is unique, the reported associations are crude (unadjusted) measures. Thus, the study is limited by its inability to address the potential impact from other variables, and whether associations would differ between sample subgroups. These questions may be a future line of research that may augment the results of the current study.

This study employed self-reported data alone. Thus, some responses may be biased by social desirability and thus influenced by the perception of relevant norms. Moreover, a selection bias is possible. This means that in some respects, the study participants, recruited by convenience, based on their own interest and willingness to participate, may have been different from non-participants.

Conclusion

This study of occupational therapy students found that the ASSIST has a well-functioning three-factor structure. Moreover, the analysis of associations across subscales lends support to the notion of 'productive' study approaches, a concept encompassing deep and strategic behaviors. Surface approach subscales were found to be inversely associated with some of the deep and strategic approach subscales, indicating that students demonstrating one type of unproductive study behavior may need guidance that extends beyond the first detected problematic behaviors to help students see connections between content areas and their future applicability.

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Table 1. Factor solution and internal consistency of the *Approaches and Study Skills Inventory for Students* (n = 171)

Item	Factor 1	Factor 2	Factor 3	Comm.
Organized study	**0.85**	0.06	-0.14	0.73
Time management	**0.83**	0.10	-0.17	0.69
Achieving	**0.82**	0.16	-0.36	0.74
Monitoring effectiveness	**0.65**	**0.43**	-0.03	0.51
Alertness to assessment demands	**0.51**	0.19	0.12	0.30
Relating ideas	0.09	**0.82**	-0.08	0.69
Use of evidence	0.27	**0.74**	0.11	0.58
Interest in ideas	0.12	**0.69**	-0.35	0.58
Seeking meaning	0.16	**0.64**	-0.01	0.41
Fear of failure	-0.02	-0.03	**0.72**	0.52
Lack of purpose	-0.32	-0.11	**0.68**	0.52
Unrelated memorizing	0.04	-0.12	**0.67**	0.47
Syllabus-bound	-0.18	0.01	**0.65**	0.44
λ	3.46	1.93	1.80	
Cronbach's $\boldsymbol{\alpha}$	0.84	0.71	0.76	
Explained variance	26.6 %	14.9 %	13.8 %	
Total explained variance		**55.3 %**		

Note. Results derived from the confirmatory Principal Component Analysis with Oblimin rotation and normalization. Factor loadings are taken from the structure matrix, and **bold** type denotes loading exceeds the threshold of 0.40. Comm. = communalities. The reported Cronbach's α are based on a previous study with the same sample (Gramstad et al., 2020).