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An Investigation of the Reliability and Validity of the Utrecht-Management of Identity Commitments Scale, Adapted to Measure Students' Identity Formation Processes at their University

Estudio de confiabilidad y validez de la Escala de Manejo de Compromisos Identitarios de Utrecht, adaptada para medir procesos de formación de identidad de estudiantes en su universidad

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Abstract

The objective of this paper was to demonstrate the construct validity and predictive validity of the measurement framework presented by Crocetti, Rubini, and Meeus (2008), which was originally developed to measure the identity formation processes (such as achieving commitments) of individuals in various domains. An adapted version of the Utrecht-Management of Identity Commitments Scale (U-MICS) was used to measure university students' identity formation processes, which are a part of students' personal identities, at their university. The U-MICS seeks to measure three dimensions of identity formation: commitment, in-depth exploration, and reconsideration of commitment. A Rasch measurement approach was applied. The results showed that the multidimensional model validly represented students' identity formation processes at university (construct validity), although some items need further improvement. Suggestions for improvement are discussed. The commitment and in-depth exploration scales were positively related to students' academic achievement, while the reconsideration of commitment scale was negatively related to the same (predictive validity).

Keywords: commitment, identity development processes, university students, multidimensional Rasch modelling

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Resumen

El objetivo de este estudio es demostrar la validez de constructo y predictiva del marco de evaluación de Crocetti, Rubini y Meeus (2008), originalmente desarrollado para medir los procesos de formación de identidad de individuos (como el de lograr compromisos) en distintos ámbitos. Se usó una versión adaptada de U-MICS (Escala de Manejo de Compromisos Identitarios de Utrecht) para evaluar los procesos de formación de identidad de estudiantes universitarios con su universidad, que forman parte de la identidad personal del estudiante. La U-MICS apunta a medir tres dimensiones de la formación de identidad: compromiso, exploración en profundidad y reconsideración de compromiso. Se aplicó el método de medición Rasch. Los resultados muestran que el modelo multidimensional representa de manera válida los procesos de formación de identidad con la universidad (validez de constructo), aunque algunos ítems requieren mejoras. Se plantean sugerencias de mejoramiento. Las escalas de compromiso y exploración en profundidad se relacionan positivamente con el rendimiento académico de los estudiantes, mientras que la escala de reconsideración de compromiso se relaciona negativamente con dichos resultados (validez predictiva).

Palabras clave: compromiso, procesos de formación de identidad, estudiantes universitarios, modelamiento multidimensional Rasch

The objective of this paper was to demonstrate in a sample of university students (University of Groningen, the Netherlands) the construct validity and predictive validity of the measurement framework presented by Crocetti, Rubini, and Meeus (2008), which was originally developed to measure the identity formation processes of individuals in various domains. In the present paper, a Rasch measurement approach was applied to demonstrate the measurement properties of the framework in the university domain.

Important identity formation processes, such as making commitments, have been related to favourable educational outcomes in previous studies, for example, to successful functioning at the university (Berzonsky & Kuk, 2005). College commitment and the feeling of being connected to the university are positively associated with study progress (Allen, Robbins, Casillas, & Oh, 2008). In addition, the more students identify with the university, the more they voluntarily engage with other students and faculty members (Battista, Pivetti, & Berti, 2014). In broader terms, having a sense of belonging at the university (i.e., feeling at home at the university, enjoying the atmosphere at the university) can enhance the academic progress of students (Meeuwisse, Severiens, & Born, 2010). By contrast, lack of commitment has been related to unfavourable educational outcomes, such as underperformance (e.g., Hejazi, Shahraray, Farsinejad, & Asgary, 2009). In keeping with the suggested positive relationship between identity formation processes (such as making commitments) and favourable educational outcomes, investigating university students' identity formation processes provides the opportunity to identify students at risk for underperformance or dropping out. Particularly for students in the freshman and sophomore years, identifying those who are not committed to their universities may help prevent early dropout.

This paper uses the theoretical framework of Crocetti et al. (2008) to measure university students' identity formation processes at the university. The purpose is to demonstrate the construct validity and predictive validity of the measurement framework of Crocetti et al. (2008) in a university student sample and to investigate the measurement properties of the scales (such as reliability and model-data fit) using multidimensional Rasch analysis. Validity refers to the degree to which evidence and theory support the interpretation of test scores (American Educational Research Association [AERA], American Psychological Association [APA], & National Council on Measurement in Education [NCME], 2014). In this paper, we gather evidence based on response processes and internal structure (i.e., construct validity: the extent to which the operationalization of the construct measures what the theory suggests) and on the relationships to other variables (i.e., predictive validity: the extent to which the operationalization is associated with theoretically relevant variables). Two research questions were formulated:

1. Does the measurement framework of Crocetti et al. (2008) produce reliable and construct-valid measurements of university students' identity formation processes at the university?
2. To what extent are students' identity formation processes at the university related to their academic achievement (predictive validity)?

One advantage of applying a Rasch model is that this type of analysis can confirm that the items used evoke and define the variable as intended (Wright & Masters, 1982). A Rasch model is a stochastic model. It applies the logarithmic transformation to estimate log-odds (logit) for each item and for each respondent. Applying a Rasch model therefore provides useful insight into the appropriateness of using a particular measurement framework in a particular context; in the present paper, this is the measurement framework of Crocetti et al. (2008) in the university context. Another advantage is that a Rasch model does not assume that items are measured on an interval level, as is the case when a factor analytic approach is used. Rasch models handle Likert scale data more appropriately, that is, as ordered data instead of data on an interval level (i.e., equal distances between the response categories). Non-interval raw data are transformed into logit scale measures (for further details, see Method section). Moreover, Rasch analysis provides additional information on item thresholds (e.g., whether the thresholds of the Likert scale increase monotonically for each item) and evaluates item and person distributions in much more detail than factor analysis. Rasch analyses can therefore be used to provide suggestions for improving the measurement of psychological constructs among specific samples.

In the last decade, multidimensional Rasch analysis has found its way into the international field of educational psychology (see Ackerman, Gierl, & Walker, 2003; Korpershoek, Xu, Mok, McInerney, & van der Werf, 2015; Lee, Zhang, & Yin, 2010; Liu, Minsky, Ling, & Kyllonen, 2009; Mok, McInerney, Cheng, & Lai, 2011, 2013; Mok & Xu, 2013; Yan & Mok, 2012). Multidimensional item response models that use correlations between latent traits can be used to improve measurement precision of individual latent traits (Wang, Chen, & Cheng, 2004) through enhancing the modelling and estimation methods (Wu & Adams, 2006). Rasch analysis may result in different results than factor analysis when examining the construct validity of a measurement framework. Rasch analysis was therefore applied in the current paper to provide new insight into the construct validity of the identity formation processes construct. Hence, the present paper contributes to the literature by exemplifying an application of multidimensional Rasch analysis for the multidimensional identity formation processes construct. This is done in a student sample not frequently addressed by scholars in the field of identity development theory, that is, among young adults in the university domain.

Theoretical framework

Identity development: the process of making commitments

The identity formation processes construct follows from identity development theory literature, which is strongly grounded in the work of Erikson (1950, 1968) and Marcia (1966, 1980, 1994). As stated by Côté and Levine (2014), Erik Erikson is arguably the most influential foundational theorist in the study of identity formation (p. 91). He convincingly argued that the formation of a personal identity is one of the central developmental tasks of adolescents. In his well-cited work, he described a sequence of eight psychosocial developmental stages of identity formation. These stages represent a sequence of growth for an individual, in which a person meets and tackles the challenges of different periods of life.

Erikson's work was continued by Marcia (1966, 1980, 1994), who operationalized identity in the identity status paradigm. Marcia stated that on the behavioural level, identity development can be seen as the process of making commitments (Marcia, 1980, p. 54). Marcia (1966) proposed four different styles of coping with the identity formation task. These statuses are «modes of dealing with the identity issue characteristics of late adolescents» (Marcia, 1980, p. 161). Individuals are assigned to these identity statuses on the basis of the degrees to which they have explored or are exploring identity alternatives and to which they are committed to one of these alternatives (Vleioras & Bosma, 2005). The four identity statuses are: Identity Diffusion (low commitment, low exploration), Identity Foreclosure (high commitment, low exploration), Identity Moratorium (low commitment, high

exploration), and Identity Achievement (high commitment, high exploration). These statuses are the outcome of the identity development process. The diffusion status is considered the least adaptive status, whereas the achievement status is considered the most adaptive status among the four (Waterman, 1999).

Following this original research on identity formation and identity statuses, there has been extensive and growing literature concerning the identity development of adolescents and young adults (for recent review studies and overviews, see Bosma, 1985; Klimstra, Hale, Raaijmakers, Branje, & Meeus, 2010; Kroger, 2000; Kroger, Martinussen, & Marcia, 2010; Meeus, 2011; Meeus, Iedema, Helsen, & Vollenbergh, 1999; Meeus, van de Schoot, Keijsers, Schwartz, & Branje, 2010; Meeus & de Wied, 2007; Waterman, 1999). In recent years, growing attention has been given to the school environment as a relevant life domain for identity development. That is, the identity formation process partly takes place in the school environment (Eccles & Roeser, 2011; Faircloth, 2009; Flum & Kaplan, 2012; Gee, 2001; Kaplan & Flum, 2012; Lannegrand-Willems & Bosma, 2006; Rich & Schachter, 2012). Since adolescents spend many hours per day at school, the school environment is assumed to influence their lives substantially. As stated by Faircloth (2012), «Identity can be seen as a type of ongoing negotiation of participation, shaped by —and shaping in response— the context(s) in which it occurs» (p. 186). Flum and Kaplan (2012) similarly argue that school as a social community provides «a relational web, a system of relations that creates meaning» (p. 241). The identity development process continues through late adolescence (Klimstra, Hale, Raaijmakers et al., 2010; Meeus et al., 1999, 2010) and even continues beyond young adulthood (Kroger et al., 2010; see also Frisen & Wangqvist, 2011; Luyckx, Klimstra, Duriez, Schwartz, & Vanhalst, 2012) until individuals develop more stable identity dimension profiles. Similar to the school environment of adolescents, the university context is therefore considered an important life domain for identity formation among young adults.

University students' identity formation processes

The present study intends to advocate a broadening of focus by investigating identity formation processes in a sample of university students. The theoretical framework of Crocetti et al. (2008) was used to measure university students' identity formation processes at the university. Meeus (1996) and Crocetti et al. (2008) continued the work of Erikson and Marcia and developed a three-dimensional model of identity formation (the so-called U-MICS) that can be used to assess people's identity in different domains (e.g., in school, in friendships, or in religion). The model was developed for assessing the content of commitments in a number of areas, the strength of these commitments, and the amount of exploration of each area. In the present paper, the university is the content area of primary focus.

Crocetti et al.'s (2008) model of identity formation consists of three dimensions. The first dimension is labelled *commitment* and refers to «a choice made in an identity-relevant area and as the extent to which one identifies with that choice» (p. 218); in other words, being committed to one's choice of identity. The second dimension is labelled *in-depth exploration* and refers to the extent to which adolescents explore current commitments actively, meaning the way they deal with existing commitments, and to what extent they are actively engaged in investigating relationships (see also Klimstra, Hale, Raaijmakers et al., 2010). The commitment and in-depth exploration dimensions followed from Marcia's (1966) identity status paradigm. Marcia described four distinct identity statuses, based on the amount of commitment and exploration that adolescents experience. The third dimension is labelled *reconsideration of commitment* and refers to comparing current commitments with other possible alternatives. It reflects uncertainty about commitments. It therefore also includes people's efforts to «change present commitments because they are no longer satisfactory» (Crocetti et al., 2008, p. 209). This third dimension was not part of Marcia's theoretical framework, but was introduced by Meeus (1996) in order to understand how adolescents construct and revise identity of time. Confirmatory factor analyses revealed that the three-factor model of Crocetti et al. (2008) provided a better fit than alternative one- and two-factor models, and that the three-factor model applied to male and female subsamples and to early and middle adolescent age groups. Moreover, the three dimensions were associated with other relevant psychological constructs (e.g., measures of personality, psychosocial problems, and parent-adolescent relations) in the expected directions.

In the present study, the items included in the three original scales were adapted to the university context to be able to measure students' identity formation processes in the university domain. As stated in the introduction, an investigation of university students' identity formation processes can help identify students at risk for underperformance or dropout. Following Crocetti et al.'s measurement framework, relatively low scores on the first two dimensions (*commitment* and *in-depth exploration*) and a relatively high score on the third dimension (*reconsideration of commitment*) can generally be seen as unfavourable. If the construct validity and predictive validity of Crocetti et al.'s measurement framework is found to be sufficient among university students in our study, the scales could be used by other scholars to identify students at risk in the university domain.

Method

Participants

The sample of participants consisted of 80 students from the University of Groningen, Faculty of Behavioural and Social Sciences, in the Netherlands. The students had the opportunity to respond to the questionnaire via the online study platform available to all students from the faculty (response rate 2%). The sample included 68 females (85%) and 12 males (15%). Forty-five students were of Dutch origin (56%), 20 of German origin (25%), 11 from other European countries (14%), and four from non-European countries (5%). Students were, on average, 22 years old. In total, 34 students had just started their university studies, 16 students had studied at the university for a maximum of two years, and 30 students had studied at the university for two and a half years or longer.

Variables and instruments

Students' identity formation processes at the university. The U-MICS (Crocetti et al., 2008) was used to measure students' identity formation processes. The items were adapted to the university context (see Appendix A). The instrument comprises three subscales: commitment (five items), in-depth exploration (five items), and reconsideration of commitment (three items). Sample items include: «My university gives me certainty in life» (commitment), «I think a lot about my university» (in-depth exploration), and «I often think it would be better to try to find a different university» (reconsideration of commitment). A five-point Likert scale was used for the responses. The categories were labelled: *completely untrue* (0), *untrue* (1), *sometimes true/sometimes not* (2), *true* (3), *completely true* (4). The instrument was administered in English to assure that non-Dutch students of the faculty were also able to participate in the study. Because English scientific literature is frequently used in the courses at the University of Groningen, we believe it is reasonable to assume sufficient proficiency in English to understand the administered items.

Academic achievement. The students indicated (self-report) their average academic grade (on a scale from one to 10, with six meaning passing the exam, and with 10 being the highest possible score) that they obtained for the courses they had taken in the past academic year. In the Netherlands, this 10-point scale is the official scale used for assessments (written assignments, end-of-course tests) in all types of education. This information was available for 45 students, since the other 35 students had not received any assessments yet (neither written assignments nor end-of-course tests). The average academic grade obtained by the 45 students was a 7.3 (*SD* 0.7), ranging from 5.0 to 9.5.

Analyses

Descriptive results (mean logit scores and standard deviations) are presented for the three factors (commitment, in-depth exploration, reconsideration of commitment) suggested in Crocetti et al.'s (2008) measurement framework. These logit scale values (calculated on the basis of transformed non-interval raw data) have constant interval meaning. Non-parametric correlation estimates (Spearman's Rho) are reported between the three factors and students' academic achievement.

As stated by Adams, Wilson, and Wang (1997), the Multidimensional Random Coefficient Multinomial Logit (MRCML) model integrates many existing Rasch models, such as the simple logistic model (Rasch, 1961), the linear logistic latent trait model (Fischer, 1973), the Rating Scale Model (Andrich, 1978), the Partial Credit Model (Masters, 1982), and the ordered partition model (Wilson, 1992). In this paper, the MRCML model that was applied is based on the Andrich (1978) Rating Scale Model.

The general purpose of the Rasch model is to extract from suitable data a useful definition of the intended variable (in this case, identity formation processes) and then to measure persons (in this case, university students) on this variable (Wright & Masters, 1980). The original Rating Scale Model (Andrich, 1978) assumes unidimensionality, which assumes that the items are working together to define a recognizable and meaningful (i.e., construct valid) variable. This implies that item calibrations are sufficiently spread out to define distinct levels along the measured variable (Wright & Masters, 1980). Additionally, the model requires that the responses of each person (person's thetas) are in general agreement with the ordering of items (item difficulty) by the majority of persons; otherwise, there is a misfit between the estimated person's thetas and the item difficulties. The general idea behind applying a Rasch model to empirical data is therefore an assessment of item fit (how well do responses to each item fit the expectations of the measurement model) and of person's fit (how well do the responses of each person fit the expectations of the model) (Wright & Masters, 1980, p. 90).

The Rating Scale Model applies logarithmic transformation to estimate log-odds (logit) of each item (item difficulty parameters) and each person (person's thetas) included in the analysis. The logit is the natural logarithmic scale of the odd ratio, which converts the values from two measures (items and persons) into a common scale. For rating scale data, the scales have a difficulty estimate as well as a series of thresholds. The difficulty of each item is based on the way in which the respondents actually responded to that item in practice (Bond & Fox, 2001). The threshold is the level at which the likelihood of failure at a given response category (below the threshold) turns to the likelihood of success at that category (above the threshold; Bond & Fox, 2001, pp. 68-70). Success on a rating scale can thus be interpreted as an endorsement of a particular response category (e.g., *completely true*). Failure is then interpreted as failure to endorse a particular response category. For the items, statements with high scores are statements that students were inclined to endorse, whereas statements with low scores are statements that students were disinclined to endorse.

An important note regarding the analyses is that some students in our sample had scored the lowest possible response category on all three items of the third scale (reconsideration of commitment). Due to the bias that this floor-effect may cause, these scores were recoded into missing as suggested by one of the reviewers of this manuscript. The analyses on the third dimension were therefore based on a sample of 56 students (70% of the original sample). The analyses on the first and second dimension were based on the whole student sample of 80 students.

In the Rating Scale Model (Andrich, 1978), it is assumed that the threshold spacing is similar for all items included in the analysis. In the paper, a Rating Scale Model (instead of a Partial Credit Model) was applied, since it was conceptualised that the responses across items in the same scale had the same meaning (they share the same rating scale structure[1]). That is, all items were intended to measure students' endorsement of statements about their identity formation processes using the same rubrics. The measurement properties of the three factors were analysed by using a MRCML model. This is a multidimensional Rasch model for polytomous (e.g., Likert-type) scales (Adams et al., 1997). Such a model can simultaneously calibrate all factors and increase measurement precision by taking into account the correlations between the factors (Wu & Adams, 2006). The ConQuest programme (version 2.0; Wu, Adams, Wilson, & Haldane, 2007) was used to perform the analysis.

Mean square (MNSQ) fit statistics were used to determine how well the empirical data met the requirements of the Rasch model. These fit statistics (chi-square ratios) are the mean values of the squared residuals; in other words, of the differences between the observed values and values predicted by the Rasch model. Two chi-square ratios were used to evaluate item fit, namely infit (weighted) and outfit (unweighted) mean square statistics. The infit statistic is calculated on the basis of how closely

[1] A Partial Credit Model (Masters, 1982) specifies that each item has a unique rating scale structure.

respondents' endorsement levels align with the item difficulty level (i.e., to what extent the item is easily endorsed or difficult to endorse) and gives more weight to those items with better alignment. The outfit statistic is an unweighted statistic. Infit and outfit statistics have an expected value of 1 and can range from 0 to infinity (Linacre, 2002). Values between 0.50 and 1.50 are indicative of «useful fit» (Linacre, 2002) for Rating Scale Models (Andrich, 1978); however, other researchers suggest a narrower range of values between 0.75 and 1.30 (e.g., Bond & Fox, 2007). MNSQ fit statistics based on the multidimensional model and based on three separate unidimensional models are presented. Person separation reliabilities are reported for each scale. Wright maps are added to show the item difficulty parameter estimates and the extent to which the items align with the respondents (students' thetas).

Results

With regard to the first research question (*Does the measurement framework of Crocetti et al. (2008) produce reliable and construct-valid measurements of university students' identity formation processes at the university?*), the construct validity of the adapted U-MICS questionnaire was found to be acceptable. The items of the three scales captured the multidimensional nature of the identity formation processes construct, which was demonstrated by the model fit indices and parameter estimates. The details are presented below.

Step calibrations for all items increased monotonically from -3.390, -0.786, and 0.760 to 3.417 logits. There was a linear trend in the Likert scales, the distances between the steps being 2.604, 1.546, and 2.657, respectively. This result indicates that each step defines a distinct position on the scale. The items functioned adequately in the three-factor model, since all distances between the steps were larger than one (Linacre, 2002). Table 1 shows the Maximum Likelihood Estimation (MLE) person separation reliabilities and the factor correlation matrix for the three-factor model.

Table 1
MLE person separation reliabilities and the factor correlation matrix

3-factor model[a]	Reliability[b]	Commitment	In-depth exploration	Rec. of commitment
Commitment	0.82	1		
In-depth exploration	0.85	0.18	1	
Reconsideration of commitment	0.72	-0.67	-0.01	1

Note: [a] Final deviance of the model was 2188.034 (22 parameters estimated). [b] MLE person separation reliability.

MLE person separation reliabilities greater than .80 are considered acceptable. The commitment scale (.82) and the in-depth exploration scale met this criterion (.85), while the reconsideration of commitment scales' reliability was slightly lower (.72). All in all, the scales were able to differentiate the students on the measured variables, although some improvement of the person separation reliability on the third scale would be desirable.

The results (see Table 2) further showed that the item MNSQ infit (weighted fit) based on the multidimensional model varied between 0.53 and 1.47 and that MNSQ outfit (unweighted fit) varied between 0.54 and 1.44. The MNSQ infit based on the unidimensional models (separately for each dimension) varied between 0.69 and 1.28, while MNSQ outfit varied between 0.69 and 1.27. All item values had fit statistics within bound of «useful fit» (i.e., between 0.50 and 1.50; Linacre, 2002), even when the 95% confidence intervals were inspected. However, four out of 13 items did not meet the narrower cut-off criteria suggested by Bond and Fox (2007) when evaluating the item fit statistics based on the multidimensional model (inspection of the unidimensional models showed that only item 11 did not meet these narrower cut-off criteria). In these cases, the data did not conform to the model. More specifically, three items crossed the lower bound of 0.75. This was the case for Item 1 (infit 0.65 [t = -2.6]; outfit 0.64 [t = -2.5]) and Item 2 (infit 0.74 [t = -1.8]; outfit 0.74 [t = -1.8]), both part of the commitment scale, and Item 11 (infit 0.53 [t = 2.6]; outfit 0.54 [t = 2.7]), part of the reconsideration of commitment scale. For these items, the fit of data to the model was better than expected (Smith, 1996). Moreover, one item crossed the upper bound of 1.30, namely item 10 (infit

1.44 [t = -2.9]; outfit 1.47 [t = -3.0]), which was part of the in-depth exploration scale. These values indicate the existence of unmodelled variance. The other nine items met the more stringent requirements of the Rasch model; they fitted the Rasch model well. Items 1, 2, 10, and 11 (see Appendix A) need to be further enhanced in order to better fit the three-factor Rasch model. This is particularly the case for Items 1 and 10, because of the t-values less than -2 (less variance than modelled), and for Item 11, because of the t-values greater than +2 (more variance than modelled). These items can be interpreted as having less compatibility with the model than expected (p < .05; Wright & Masters, 1982). Suggestions for improving these items are included in the discussion section.

Table 2
Item Infit and Outfit MNSQ (Statistics based on multidimensional model and unidimensional models)

	Infit MNSQ [95% confidence interval]	Outfit MNSQ [95% confidence interval]
Statistics based on multidimensional model:		
Commitment:		
Item 1	0.65 [0.70 – 1.30]	0.64 [0.69 – 1.31]
Item 2	0.74 [0.69 – 1.31]	0.74 [0.69 – 1.31]
Item 3	0.75 [0.70 – 1.30]	0.75 [0.69 – 1.31]
Item 4	1.03 [0.70 – 1.30]	1.04 [0.69 – 1.31]
Item 5	0.89 [0.69 – 1.31]	0.90 [0.69 – 1.31]
In-depth exploration:		
Item 6	1.22 [0.71 – 1.29]	1.23 [0.69 – 1.31]
Item 7	1.18 [0.71 – 1.29]	1.20 [0.69 – 1.31]
Item 8	1.01 [0.70 – 1.30]	0.99 [0.69 – 1.31]
Item 9	1.30 [0.70 – 1.30]	1.29 [0.69 – 1.31]
Item 10	1.44 [0.71 – 1.29]	1.47 [0.69 – 1.31]
Reconsideration of commitment:		
Item 11	0.53 [0.63 – 1.37]	0.54 [0.69 – 1.31]
Item 12	0.99 [0.64 – 1.36]	0.99 [0.69 – 1.31]
Item 13	1.07 [0.63 – 1.37]	1.03 [0.69 – 1.31]
Statistics based on unidimensional models:		
Commitment:		
Item 1	0.82 [0.69 – 1.31]	0.80 [0.69 – 1.31]
Item 2	0.87 [0.69 – 1.31]	0.87 [0.69 – 1.31]
Item 3	0.93 [0.69 – 1.31]	0.93 [0.69 – 1.31]
Item 4	1.27 [0.70 – 1.30]	1.27 [0.69 – 1.31]
Item 5	1.04 [0.69 – 1.31]	1.07 [0.69 – 1.31]
In-depth exploration:		
Item 6	1.08 [0.71 – 1.29]	1.08 [0.69 – 1.31]
Item 7	0.98 [0.71 – 1.29]	1.00 [0.69 – 1.31]
Item 8	0.96 [0.70 – 1.30]	0.94 [0.69 – 1.31]
Item 9	1.04 [0.70 – 1.30]	1.03 [0.69 – 1.31]
Item 10	1.05 [0.71 – 1.29]	1.06 [0.69 – 1.31]
Reconsideration of commitment:		
Item 11	0.69 [0.60 – 1.40]	0.69 [0.63 – 1.37]
Item 12	1.07 [0.61 – 1.39]	1.07 [0.63 – 1.37]
Item 13	1.28 [0.65 – 1.35]	1.26 [0.63 – 1.37]

The Wright maps (the item-person maps) for the three factors are presented in Figures 1 to 3. These maps give a visual impression of how well the item difficulty levels (item difficulty parameters) target the students' endorsement levels (students' thetas). Both distributions are matched on the two sides of the Rasch measurement scale. In the graphs, the values on the right side refer to specific thresholds of the items, for example, 3.4 means Item 3, threshold 4. The items that were difficult to endorse are placed at the top, and the items that were easier to endorse are placed further at the bottom. Each x on the left side refers to a particular number of respondents.

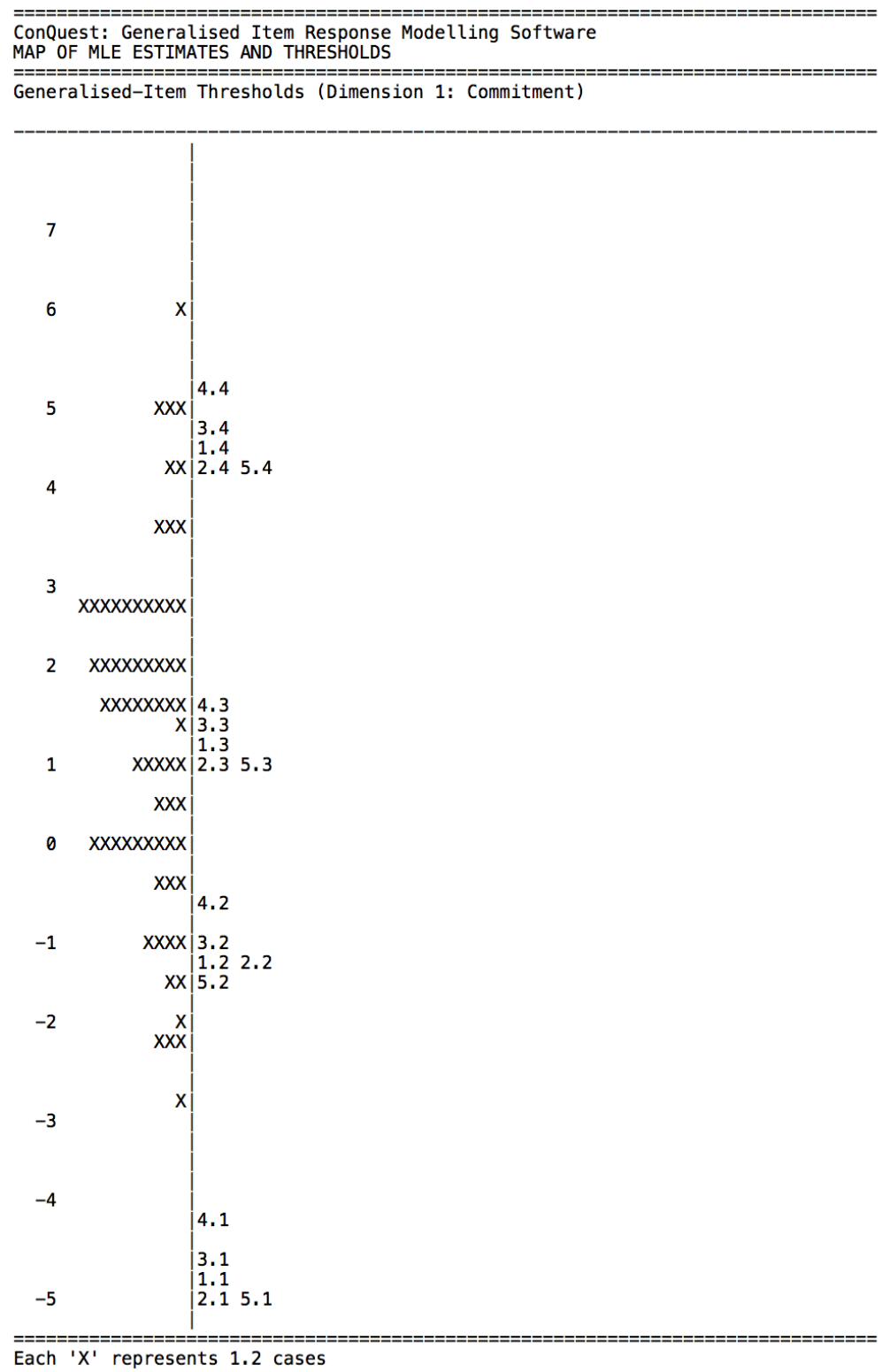

Figure 1. Wright map of dimension 1: Commitment (N = 80).

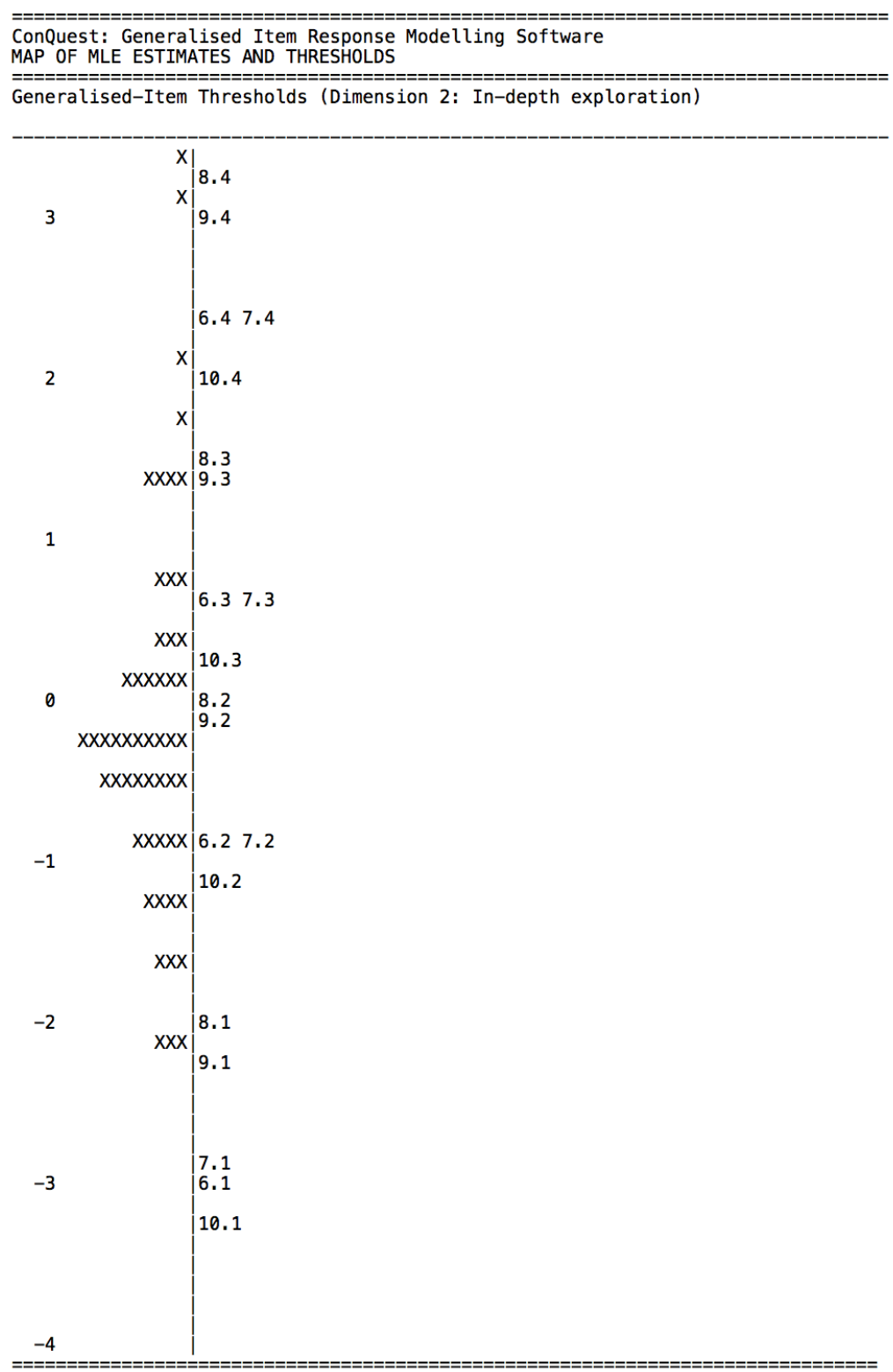

Figure 2. Wright map of dimension 2: In-depth exploration (N = 80).

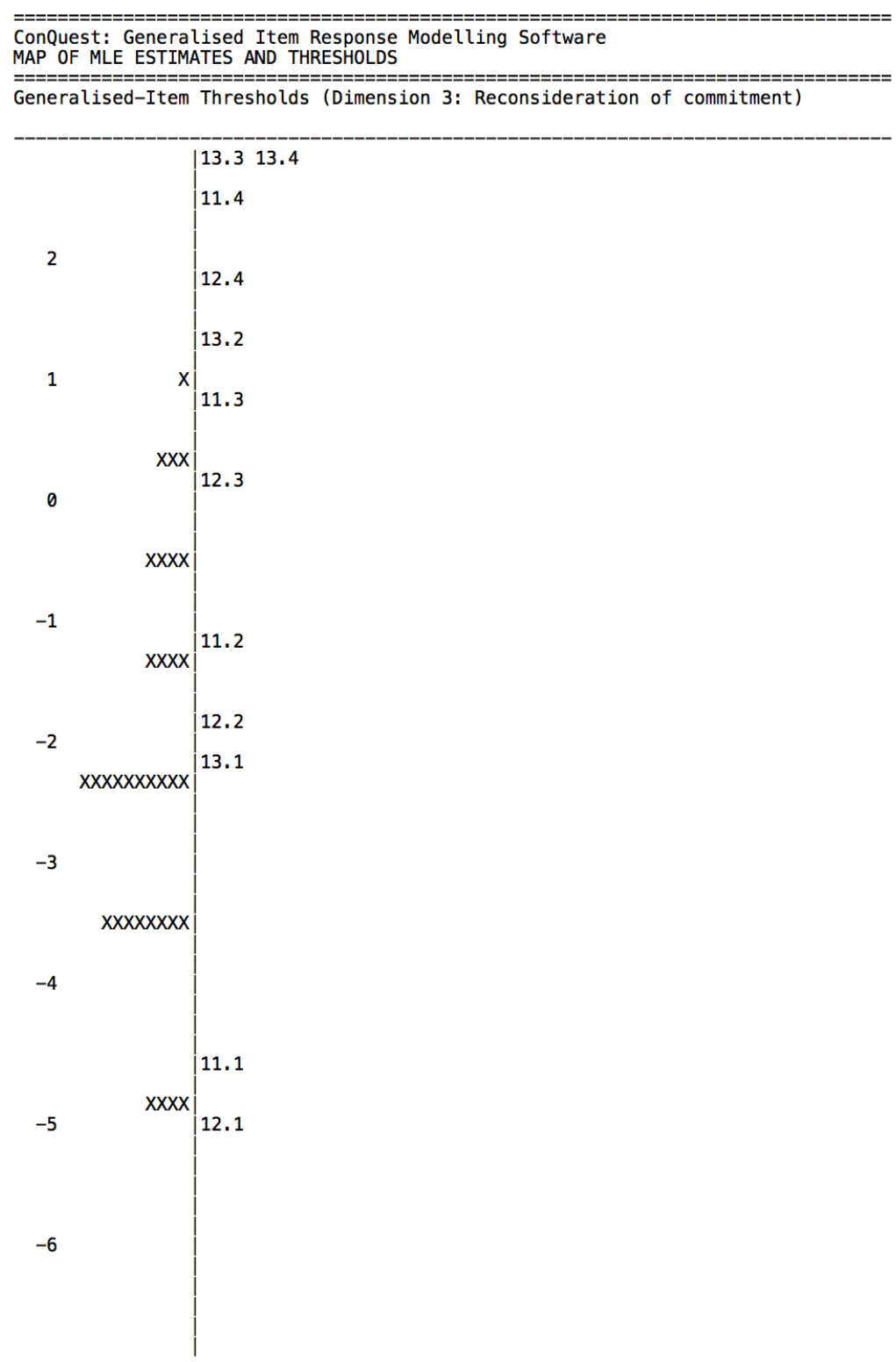

Figure 3. Wright map of dimension 3: Reconsideration of commitment (N = 56).

For all three scales, the Wright maps show a good match between item and person distributions. For these dimensions, there is a good coverage of the endorsement levels by the distribution of items together with the item thresholds.

With regard to the second research question (*To what extent are students' identity formation processes at the university related to their academic achievement (predictive validity)?*), the following results were obtained. First, Table 3 shows the mean logit scores and the standard deviations on the three identity formation processes scales.

Table 3
Mean logit scores and standard deviations of the three factors

	Mean logit scores	Standard deviations
Commitment	1.21	0.20
In-depth exploration	0.95	0.26
Reconsideration of commitment	0.67	0.26

Correlations among the three factors were estimated with the ConQuest software (see Table 1). Spearman's Rho was used to estimate the correlations between the three-factor logit scores and academic achievement variable (average grade obtained).[2] The correlation coefficients reveal that the association between the three factors and academic achievement was generally low, with the strongest association found for the commitment scale (r = .25; p < .10). The higher the students' commitment (and to some extent their in-depth exploration), the higher the students' average grade obtained (or vice versa). This finding is in line with a prior study on students' commitment to the university with regard to the direction of the association; that is, a positive association between commitment and successful functioning at the university (e.g., Allen et al., 2008 found a correlation of .13 between students' commitment to college and their first-year GPAs). The correlation between in-depth exploration and the average grade obtained was also positive (r = .22). In line with the content of the third scale, reconsideration of commitment, the correlation between this scale and the average grade obtained was negative (r = -.19). For the latter two scales, there is no information from prior studies to compare the direction and magnitude of these correlations among university student samples, but the direction of the associations seem to be in line with the identity development theory on which the scales were developed.

The three-factor structure of the construct as suggested by Crocetti et al. (2008) was replicated in the current student sample. In line with the U-MICS validation study using a sample of Swiss college students (Zimmermann, Mahaim, Mantzouranis, Genoud, & Crocetti, 2012), a negative correlation between commitment and reconsideration of commitment was found, indicating that students who hold stronger commitments are less prone to reconsider their commitments. The negative correlation was stronger in the present sample (r = -.68) than in the Swiss study (r = -.26; Zimmerman et al., 2012), which can be explained by the fact that in the present sample, many students had just started their studies at the faculty and therefore did not reconsider their commitment to the university to the extent that more experienced students would. The positive correlation between commitment and in-depth exploration was less strong in our study (r = .17), though in the same direction as Zimmermann et al. (2012), who found a correlation of .43. The non-existent relation between in-depth exploration and reconsideration of commitment is exactly in line with Zimmerman et al.'s study (2012) (r = .04). Those who are reconsidering their commitments are less likely to explore commitment alternatives at the same time.

[2] Spearman's Rho estimates may be biased to some extent, since the estimates were not part of the estimates produced by the ConQuest program (and thus not based on the estimated covariance between the population distributions).

Discussion

In Rasch analysis, ordered data are handled appropriately, providing additional information regarding item thresholds. The results of this study showed that all item thresholds in the three-factor model increased monotonically, in line with the Likert scale type response categories. Nevertheless, several items need further refinement to increase the construct validity of the scales (Items 1, 10 and 11). For example, Item 10 (and also Item 9) concerns in-depth exploration of students' commitment to the university through talking to other people, whereas the other items from the in-depth exploration scale do not necessarily involve this aspect of exploration. Those other items focus on exploration that students undertake individually. Although the items did load on the same factor, it appears that the scale covers two different aspects of exploration. The first suggestion to improve the scales would therefore be to investigate whether in-depth exploration should be split into two aspects (based on identity formation theory) and, accordingly, develop additional items to measure these two aspects separately. Moreover, Item 10 (*«I often talk with other people about the University of Groningen»*) was relatively easy for students to endorse as compared to the other items on the in-depth exploration scale. A more concrete formulation, such as, *«I often talk with people outside the university about going to the University of Groningen,»* may solve this issue, because it is imaginable that students often talk with other students about their studies at the university. The second suggestion to improve the scale is related to Item 1 (*«The University of Groningen gives me security in life»*) of the commitment scale, which can be interpreted in various ways (security with regard to what aspect of one's life?). Since 42 out of 80 students responded «*true*» and only three students responded *«completely true»* (and none of them *«completely untrue»*), it seems that the wording of the category does not match with this item. It is therefore suggested to change the wording of the item into a less strict statement (*«gives me»* is, in my view, too strong, because students will never know that for sure), such as, for example, *«The University of Groningen makes me feel secure about my future life.»* The third suggestion to improve the scales is related to Item 11 (*«I often think it would be better to try to find a different university»*) of the reconsideration of commitment scale, but also Item 13 (*«In fact, I'm looking for a different university»*), for which we found a strong floor effect. Almost 70% of the students responded *«untrue»* or *«completely untrue»* to Item 11, and this was the case for almost 90% of the students for Item 13. These findings indicate that the items were too difficult to endorse. The students were disinclined to endorse these reconsideration of commitment statements. This is presumably due to the fact that a large group of students in this sample had just begun their studies at the university. It is unlikely that they would already be looking for a different university. Therefore, items that are easier to endorse would be necessary for this dimension when using Crocetti et al.'s (2008) measurement framework among samples of university students in their freshmen year. Suggestions to improve this third dimension include: (a) increasing the number of items to five (in line with the other two dimensions) to improve the reliability of the scale, for example, *«I'm sometimes in doubt as to whether I chose the right university»* and *«I'm sometimes in doubt as to whether this university is giving me what I need»* both focusing more on the reasons behind reconsideration of commitments; (b) rephrasing Items 11 and 12 by replacing the word *«often»* with *«sometimes»* so that students might use the extreme response categories more often; and (c) rephrasing Item 13 into a less strict item, for example, *«In fact, I'm looking for opportunities to switch to a different university»,* to make the statement easier to endorse.

This study is not without limitations. Firstly, the sample size of 80 students was rather small. Linacre (2002) suggested that at least $25^{*}(m + 1)$ subjects are needed for stable results, in which m is the number of categories in the rating scale. A sample of 150 participants would therefore be necessary to obtain stable results. The response rate was very low (2%), since students were invited via an online platform of the faculty that is not frequently checked by most students. Unfortunately, this was the only possibility to collect data among the students, because permission was not given to approach the students directly. Although the response group is homogeneous with regard to study interests (behavioural and social sciences), it is unclear whether they form a representative student sample with regard to background characteristics. Additionally, the fact that it was only possible to use the responses of 56 students for the third dimension due to a strong floor effect is problematic for adequately assessing the validity of this dimension. The floor effect could be due to how the items were formulated and the accompanying response categories (as indicated by the fit indices), but also due to the sample used. Therefore, more research using larger sample sizes and various university student samples is needed to adequately test the validity of this dimension. Secondly, as a consequence of the small response group, the data provided less than 10 observations for one of the response categories for some

of the items (those of the reconsideration of commitment scale), which violated the assumptions of the Rasch model. Linacre (2002) presented guidelines that, when using rating scale data, at least 10 observations for each category are needed. When fewer observations are available in the data, it is normally advised to combine adjacent categories (resulting in a three- or four-point Likert scale) to obtain a robust structure of high frequency categories. However, in this sample, the person separation reliabilities for all three scales dropped considerably when following this procedure, which is why it was decided to keep the original five-point Likert scale. It is therefore advisable to replicate current findings in a larger student sample. These limitations stress the fact that the results presented should be interpreted with caution. The empirical data were useful for exemplifying the application of multidimensional Rasch analysis, but replication of the study is strongly recommended.

An additional suggestion to further improve the measurement framework might include experimenting with the labels used for the response categories and the number of response categories. Although I found distances between the steps larger than one in the sample, it is arguable that people cannot easily distinguish between, for example, *true* and *completely true*. Since university students in the Netherlands are usually familiar with five-point Likert scales, they were apparently able to make an adequate distinction between the categories anyway; however, it may be useful to try different labels among various samples (see also Arce-Ferrer, 2006). Other response categories (different labels or fewer categories) may produce different results. The presence of common response styles (see, for example, Baumgartner & Steenkamp, 2001), such as extreme responses (using the extreme endpoints of the rating scale), acquiescence (endorsing items regardless of content), or midpoint responding (using only middle categories), need further investigation to acquire more evidence for the construct validity of the identity formation processes construct. For example, a four-point Likert scale may produce better item fit, because eliminating the middle category to some extent eliminates the differences in students' tendency to give extreme responses or moderate (midpoint) responses.

The positive correlation found between commitment and academic achievement gives an indication of the predictive validity of the identity formation processes construct. Nevertheless, more information about students' academic achievements would be necessary to assess this relationship further, since information about grades was unavailable for some of the students. Ideally, a longitudinal research design would be used in future studies, in which students' identity formation processes at the university and their academic achievements are measured on multiple occasions. This is particularly important for measuring the separate identity formation processes, because short-term fluctuations in commitments and reconsideration of commitments have been suggested in the literature (Klimstra, Hale III et al., 2010).

Notwithstanding these limitations and suggestions for further study and ways to improve the scales, this paper presented some new insights into the reliability, construct validity, and predictive validity of the multidimensional identity formation processes construct in a sample of university students.

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Appendix A

The items adapted from U-MICS (Crocetti et al., 2008):

Commitment

(1) The University of Groningen gives me security in life.
(2) The University of Groningen gives me self-confidence.
(3) The University of Groningen makes me feel sure of myself.
(4) The University of Groningen gives me security for the future.
(5) The University of Groningen allows me to face the future with optimism.

In-depth exploration

(6) I try to find out a lot about the University of Groningen.
(7) I often reflect on the University of Groningen.
(8) I make a lot of effort to keep finding out new things about the University of Groningen.
(9) I often try to find out what other people think about the University of Groningen.
(10) I often talk with other people about the University of Groningen.

Reconsideration of commitment

(11) I often think it would be better to try to find a different university.
(12) I often think that a different university would make my life more interesting.
(13) In fact, I'm looking for a different university.