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ARTICLE

Well-being and ill-being on campus

Philip S. Morrison · Ivy Liu · Dylon Zeng

Abstract: Enquiries into the low mental health of university students are exposing the relative merits of competing theoretical and empirical models. The debate is important because the models used to characterise the problem imply alternative causations, consequences, and possible interventions. The purpose of our study is to highlight the value of recognising the presence of both well-being and ill-being within individual students (the dual continua model) as opposed to viewing their well-being and ill-being as opposite ends of a single continuum of mental health (the bipolar model). Using a baseline survey completed by 1,581 first year undergraduate students who enrolled in a New Zealand university at the beginning of 2019, we document the inverse correlation between their scores on the WHO-5 measure of psychological well-being and the PHQ-9 measure of psychological distress or ill-being. Contrary to the assumption of the bipolar model we find their inverse correlation is not strong and that many students are located off the diagonal, some reporting both high well-being *and* high ill-being over the two-week reference period and many more recording low scores on both screening instruments. We represent this heterogeneity in terms of six clusters of students based on a latent profile analysis of their two scores. We also find that students' well-being and ill-being respond differently to variations in their physical and financial health both in cross-section and over time, confirming that well-being and ill-being can also be functionally independent. The results are important both diagnostically and in terms of the interventions they suggest.

Keywords: university student; well-being; WHO-5; ill-being; PHQ-9; complexity; dual factor model; dual continua model; latent profile analysis; finite mixture modelling

1. Introduction

The mental health of university students has received sustained attention from a range of disciplines using samples from many different countries. Most base their inferences on a single scale, either psychological distress or well-being, while at the same time acknowledging that mental health is multi-dimensional.[1] Single scale measuring instruments typically place well-being at one end of a single continuum and ill-being at the other implying that a decline in well-being means a rise in ill-being. Based on this bipolar model clinicians have addressed mental health primarily by relieving psychopathology while well-being researchers have promoted the raising of hedonic and eudaemonic well-being.

The simplistic one-dimensional model of mental health is gradually being superseded by the dual continua or dual factor model which recognises that subjective well-being and ill-being are

[1] We employ two spellings of well-being in our text. The unhyphenated version is used to name the YOU Student Wellbeing Survey and any author's particular spelling in their titles. Elsewhere we employ the hyphen to invoke the symmetry between well-being and ill-being.

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both related *and* independent measures. Resting on more solid theoretical and empirical foundations, the dual continua model argues not only that a subject's well-being and ill-being can co-exist within a reference period, but that the two can also respond differently and independently to a range of different influences, resulting in different consequences and implying different interventions.

We obtain measures of subjective well-being and ill-being from a voluntary sample survey of 1,581 students who enrolled in first year courses at a major New Zealand university in early 2019. We use two well-known screening instruments to measure well-being, the World Health Organisation five question survey (the WHO-5), and the nine question Patient Health Questionnaire (the PHQ-9). The reference period in both cases was a two-week teaching period prior to the survey.[2]

Contrary to the assumptions of the bipolar model, we found that the inverse correlation of the two measures was not strong, and that any given student could report high well-being *and* high ill-being, or alternatively, low scores on both instruments. Our case for accepting the dual continua model relies on the rejection of bipolarity, and we show that experiencing well-being does not preclude the presence of ill-being and that a rise in well-being need not necessarily be accompanied by a fall in ill-being.

These are salient results for university administrations, most of whom rely on single scaled instruments to capture student wellbeing. Our results, together with an expanding dual continua literature, suggest that instruments designed to measure well-being or ill-being alone may give a misleading picture of the mental health of students on campus.

1.1 Outline

We begin by recognising the substantial body of international research on the mental health of university students while also observing the largely implicit use of one-dimensional bipolar models of mental health with well-being at one end and ill-being at the other. We recount the longstanding debate over the co-existence of well-being and ill-being and the hypotheses involved in testing their independence. We introduce the YOU Student Wellbeing Survey along with two of its measuring instruments, the WHO-5 and PHQ-9. We document the limited degree to which they are inversely related on campus and how they co-vary with the student's physical and financial health at baseline and over time. The presence of several different combinations of well-being and ill-being over a student's reference period also prompted our identification of six latent clusters of student mental health. We also draw on our panel of over 350 students to estimate the degree to which changes in students' ill-being over the first six months of study were inversely correlated with changes in their well-being.

2. Literature review

The number of university students with a serious mental illness has risen worldwide since the millennium (Storrie et al., 2010) and average levels of well-being have declined (Denovan and Macaskill, 2017).[3] Earlier reviews drew similar conclusions (Robotham & Julian, 2006, Sales, Drolet & Bonnea, 2001 and Stewart-Brown et al., 2000). More recent evidence is now available

[2] The university's trimester dates run late Feb to late May (T1), mid-July to mid-October (T2) and mid- November to mid-February, (T3).

[3] The meta-analysis by Storrie et al., (2010) identified 572 articles on the topic between 2000 and 2009, Ibrahim et al. reviewed 24 articles between Jan 1990 to Oct 2010 that met their inclusion criteria (Iasiello and Agteren, 2020).

from a wide range of countries as documented in Eskin et al., (2016), Holm-Hadulla and Koutsoukou-Argyraki (2015), Bruffaerts et al., (2018) and Auerbach (2016).

The conceptual frameworks used to interpret the mental health of university students usually involve a one dimensional measure of either well-being or ill-being in an implicit acceptance of the bipolar model. Of primary concern in our paper is the extent to which students' negative and positive experiences of mental health might be independent and co-exist as dual continua, as argued by Barkham et al., (2019), Mason Stephens et al., 2023 and Iasiello et al., (2023). As social psychologist Norman Bradburn explains,

> "When we say well-being and ill-being are independent of each other we do not mean that they can occur simultaneously or that people move from positive to negative feelings and back again in a cyclical fashion. We mean that within a given period of time, such as a week or two, one may experience many different emotions, both positive and negative, and that in general there is no tendency for the two types to be experienced in any particular relation to one another. This lack of correlation means that information about the extent of positive feelings a person has experienced in the recent past does not give us any information on the extent of his negative feelings" (Bradburn, 1969: 225).

2.1 The dual continua debate

The proposition fueling the dual continua debate is whether in fact it is possible to experience both well-being and ill-being over a given reference period. While the bipolar model logically precludes the experience, the dual continua model argues that mental health is more fruitfully viewed as a higher order construct reflecting the presence of both moods and emotions. The debate reaches back to the 1950s to the writing of social psychologist Marie Jahoda whose fundamental position was that, "the absence of illness and the presence of health overlap but do not coincide" (Jahoda, 1958: 112). By the mid-1960s Bradburn noted there had still, "been no agreement on whether psychological well-being is a unidimensional variable or whether it is composed of several dimensions" (1969:8). Over a decade later the debate continued to be viewed as a,"paradox that has never been fully explained", and "a puzzling phenomenon the explanation for which is of considerable theoretical importance" (Costa & McCrae, 1980: 660, 670). Twenty years further on and the assumption that mental health was simply the absence of mental illness continued as, "one of the most simple and inexplicably untested empirical hypotheses" (Keyes, 2005: 95). Even as late as 2006 Ruff et al. were asking, "was well-being merely the flip side of psychological maladjustment or do well-being and ill-being constitute separate, independent dimensions of mental functioning?" (2006: 85).

Bradburn's research in the 1960s had an important influence on the work of Bruce Headey who, two decades later, observed how high scoring on survey items measuring satisfaction and positive feelings did not necessarily imply low scoring on those indices which focus on dissatisfaction and negative feelings (Headey, Holstrom, & Wearing, 1984: 123). Similar conclusions were drawn by Diener (1984), Diener and Emmons (1984) and Myers and Diener (1995) who stressed that valuable information would be lost by only using a single measure to capture mental health. The same point was made yet again by Huppert and Whittington (2003) and Huppert and So (2013).

Headey argued that the distinction between well-being and ill-being derived in part from reviewing two bodies of research which had little influence on each other - the social psychology literature on well-being and the psychiatric epidemiology literature on neurosis and depression (Headey et al., 1984:116). Social psychologists focused on the correlates and causes of well-being

but largely ignored indications of ill-being, whereas researchers in the field of psychiatric epidemiology focused on ill-being, on neurosis and depression rather than well-being" (Ibid:117). The result, he concluded, was that these two approaches, "slide past each other using different sets of independent variables" (Ibid: 120).

Many others have contributed to the debate, drawing attention to the presence of duality in life satisfaction (Davern and Cummins, 2006), the role of the circumplex model introduced by Russell and Carroll (1999) e.g. Larsen et a., (2001), and whether well-being and ill-being have distinct biological correlates (Ryff et al, 2006). At the same time, the debate over dimensionality is not confined to the academy because it has important consequences for health promotion. The public health field had also failed to conceptualise heath and illness as occupying two separate but intersecting continua, as pointed out by Downie et al. (1990) and later by Secker (1998:58, 68). Without such a framework explained Tudor (1996: 23), it is difficult to promote positive mental health among the mentally ill (see Payton (2009).

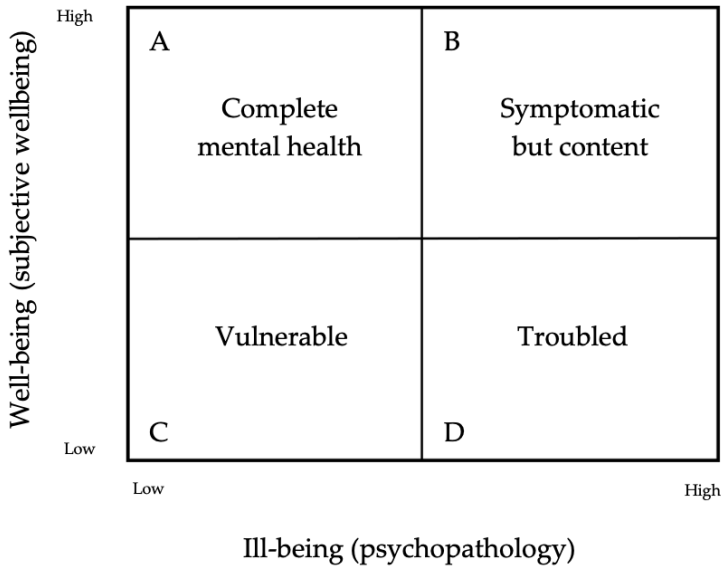
As Keyes explained, "Individuals free of mental disorder are not necessarily mentally healthy and, therefore, measuring positive mental health may be essential for understanding college students' adjustment ..." (Keyes, 2012: 126). However, in their recent review of the dual-continua model Iasiello and Agteren (2020) were only able to identify ten out of 87 papers that addressed the mental health of university students and of those, only a few mainly small sample, cross-sectional studies plus a more recent study, acknowledge the potential value of the dual continua model: Eklund, (2011), Kraiss (2022), Renshaw and Cohen, (2014), Macaskill and Denovan, (2014), Xiao (2021), Renshaw et al.(2016) and Antaramian (2015).

A majority of those applying the dual continua model dichotomise their well-being and ill-being measures to create four stereotypical states as depicted in Figure 1 which is variously referred to as the complete mental health model (CMHM) (Kim, 2017), quartered classification theory (Magalhaes and Calheiros, 2017: 442) or the quadripartite model (de Matos et al, 2023). Each replicate, with minor terminological differences, Downie's original representation (Downie et al, 1990) as reproduced in Tudor (1996: 24, Figure 1.2). According to the CMHM most respondents return high scores on well-being and low scores on ill-being and are therefore deemed to be in 'complete mental health' (quadrant A in Figure 1). A smaller proportion record well-being and ill-being above their respective cut-points in a category labelled 'symptomatic but content' (B). Those scoring below their two respective cut-points are labelled 'vulnerable' (C), and the remainder, exhibiting low well-being and high ill-being, have been labelled 'troubled', as in quadrant D.[4] In addition to interrogating the role of positive and negative life evaluations the dual continua model has also been used to raise questions about both the antecedent (upstream) and descendent (downstream) consequences of the four states.

To structure our description of student mental health we offer three tests of the axioms that support the bipolar model. The first is the principle of evaluative activation (the independent existence of well-being and ill-being) and the second is the principle of opposing evaluative activations (bipolarity) as advanced by Cacioppo & Bernston (1994) and tested by Mason Stephens et al, 2023). The third is the principle of reciprocal evaluative activation (functional independence) which we test using the panel below. With these aims in mind, we turn to the YOU Student Wellbeing Survey as applied in New Zealand.

[4] The dual continua model has also recently been applied to university staff and faculty showing that individuals, "with high levels of anxiety can simultaneously experience high or low levels of life satisfaction, quality of life, and work life balance" (Kirby et al., 2023:41). The result replicates studies of university students who express both high levels of anxiety and life satisfaction (Carver et al., 2021).

Figure 1. The dual continua (dual factor) model of mental health.



Source: Adapted from (Iasiello and Agteren, 2020) and Lyons et al. (2012).
Note: Alternative labels have been applied by Renshaw and Cohen (2014: 321): A: mentally healthy, B: symptomatic yet content, C: asymptomatic yet discontent and D: mentally unhealthy. For a six cell, 3 x 2 version see Figure 1 in Iasiello et al. (2016:436).

3. The YOU Student Wellbeing Survey

The YOU Student Wellbeing Survey is an independent research initiative undertaken by academic staff and students at Victoria University of Wellington (Te Herenga Waka). The name 'YOU' was suggested by the students themselves. The survey is the basis for a multi-cohort, longitudinal study of the mental health of students who enrolled full-time or part-time in first year courses in 2019, 2020 and 2021. The survey carried 139 questions under 28 topics and was sent electronically to all first year students via Qualtrics in April each year, two months after the start of the university's first term. The roll-out followed an advertising campaign facilitated by the university's communication team. The students were given two weeks to complete the survey and they did so in an average elapsed time of about 20 minutes.

A total of 1,591 out of the 4,682 students who enrolled in first year courses responded to the 2019 survey we use here, an overall response rate of 34 percent. Our sample size and response rate fall in the middle to high range of similar studies in the international literature. The average age of respondents was 18.3 years with three quarters being under the age of 24 years. Except for an inflated proportion of female students, the 2019 sample is broadly representative of the target population as detailed in supplement 1. Two multi-item screening instruments were used to capture the student's mental health - the World Health Organisation (WHO-5) questionnaire and the Patient Health Questionnaire (PHQ-9).[5] Both sets of questions were placed early in the questionnaire and were applied to the students' previous two teaching weeks.

[5] These two survey instruments have also been recommended as screening instruments by the OECD, Figure 2.3. p. 44 As of 2022, 30 of the 37 OECD countries use PHQ-9 and 6 use WHO-5 (OECD, 2023, p.93-94.) For a list of advantages and limitations of different tools to measure mental health see OECD, 2023, Table 2.1. p.41. For an overview of mental health tool performance on statistical quality, data collection and analysis metrics see OECD Table 3.1 p. 93. The OECD also note that screening tools are likely to overstate population level prevalence of mental disorders compared to structured interviews (Ibid, p.42-43). For further details see https://www.oecd-ilibrary.org/social-issues-migration-health/ measuring-population-mental-health_5171eef8-en

The WHO-5 index is the sum of responses to its five questions which we convert to a percentage scale as detailed in Appendix 1. The scale has been widely tested for its validity, sensitivity, and reliability: see for example DeWit (2007), Downs et al. (2017), Sischka et al. (2020), Hill et al. (2015 and Topp et al. (2015). The instrument has been administered to several previous samples of university students including Downs, et al. (2017), Ghazisaeedi, et al. (2021), Sood, et al. (2012), Sharma et al. (2022) and Liu, et al. (2012).

The PHQ-9 index is one of the most widely used measures of psychological distress (Kroenke et al, 2001) and one of the most extensively psychometrically tested (El-Den, et al., 2018, and He, 2020). It is the sum of nine questions which we also transform to a percentage scale as explained in Appendix 1. It has also been applied to numerous samples of university students including Byrd & McKinney (2012) and Garlow et al., 2008) with several more applications cited in Ghazisaeedi, et al., (2022). The PHQ-9 has also been used as the ill-being measure in two previous applications of the dual continua model (Moore et al, 2019, Xiao et al, 2021).

4. Well-being and ill-being

The application of the WHO-5 instrument to first year students entering Victoria University in April 2019 resulted in a normal distribution of scores about a median of 56 percent and a mean of 53.8 percent (+/- standard deviation 16.5). Applying the PHQ-9 resulted in a median of 29.6 percent and a mean of 33.7 percent (+/- 21.3) from the positively (right) skewed distribution.[6] Plotting the respective scores from the two instruments against one another results in Figure 2.

The bivariate distribution in Figure 2 is of particular interest for two reasons. Firstly, it serves as a 'map' of the mental health of first year students on campus by depicting the full range, from students who are flourishing (top left), to students who are languishing (bottom right).[7] Under the single continua model, we would expect university students returning a high score on the well-being instrument to record a low score on the ill-being measure, but Figure 2 shows that this is not the case for many students. Visually the points are highly dispersed; the adjusted coefficient of determination of the fitted linear regression (adj R^2) is only 0.389 meaning that less than two fifths of the variance in either measure can be explained by the other.[8] A further departure from the bipolar model is the presence of nonlinearity. The quadratic regression plotted in Figure 2 is a slightly better fit (adj $R^2 = 0.398$) and shows that well-being is not simply the reverse of ill-being but rises more rapidly at lower levels of psychological distress.

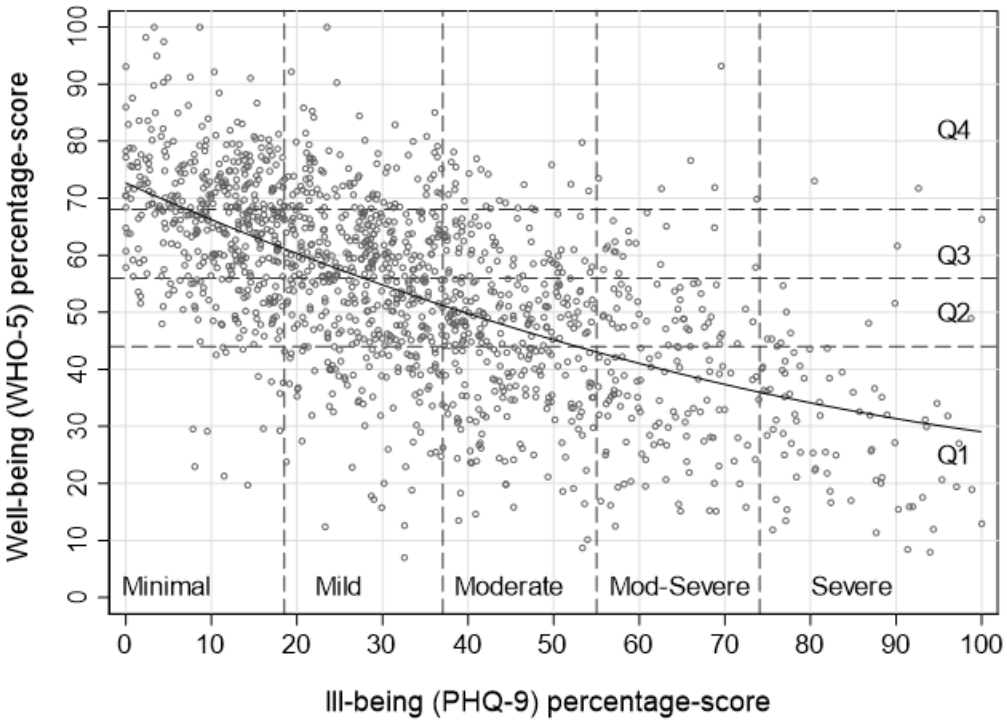
The WHO-5 is often used as a screening tool with cutoffs of ≤ 28 and ≤ 50 on the 0-100 percentage scale (Topp et al. ,2015) and OECD (2023: 79), and has been used as a generic scale for well-being across a wide range of studies. We are not focused on any particular threshold of well-being but rather on its distribution across first year students. To this end we locate the four quartiles of the well-being distribution in Figure 2, Q1 to Q4. The cut-points we apply to the PHQ-9 scores in Figure 2 are the five categories proposed by Kroenke el al., (2001). In order of increasing severity on the original 0-27 scale they are: 0-4 (minimal), 5-9 (mild), 10-14 (moderate), 15-19 (moderately severe psychological distress) and 20-27 (severe). Also see Manea (2012).

[6] A total of 57 cases are lost when the WHO-5 and PHQ-9 are matched by case. The loss is only slightly greater at 4 percent among those with low well-being compared to the loss of 3.5 percent of cases among those with high well-being. Over 96.4 percent of the first-year university students who answered the WHO-5 questions in April 2019 also answered the PHQ-9 questions.

[7] For definitions of flourishing and languishing see Westerhof and Keyes (2010: 111). Alternative definitions are offered by Zhao and Tay (2022: 3 and 8). For a contemporary application consistent with our use in the context of the dual continua model see Mason Stephens et al. (2023), Figure 1.

[8] This is virtually the same result as obtained in a recent test of bipolarity by Mason Stephens et al. (2023).

Figure 2. Well-being vs ill-being. The distribution of mental health on campus, April 2019



Source: YOU Student Wellbeing Survey. First year students at baseline, April 2019.
Note: Regressions (SE in parentheses): Linear: WHO-5 = 0.004 – 0.623(0.02) PHQ-9; adj R^2 = 0.389; N = 1,483; Quadratic: WHO-5 = -0.068 – 0.674(0.023) PHQ-9 + 0.027(0.164) PHQ-9; adj R^2 = 0.398; N= 1,483. The scores have been jittered in the plot to reduce over-printing. The "jitter" command in Stata 17 adds random noise to the observations before generating the scatterplot, yielding a better visual sense of how many observations have each pair of X and Y values.

The cells in Table 1 show that 13.2 percent of students who returned moderate and severe psychological distress sit in the bottom quartile of the well-being distribution (7.8 + 5.4 percent). Over a third of the students (35.2 percent) occupy the six cells embracing the first two quartiles of the well-being and the moderate through severe categories of the ill-being distribution.[9] By comparison, 17.1 percent occupy the top quartile of the well-being distribution and the minimal or mild levels of distress.

Table 1. The distribution of first year students over intersections of the WHO-5 and PHQ-9 scores. First year students in April 2019.

WHO-5 PHQ-9	Minimal	Mild	Moderate	Mod_Severe	Severe	WHO-5 Total
Q4: High Well-being	11.1	6.0	1.2	0.7	0.1	19.2
Q3: Moderate-High well-being	8.2	11.9	3.7	0.5	0.1	24.4
Q3: Low-Moderate well-being	4.2	9.2	7.6	3.0	0.5	24.5
Q1: Low well being	1.1	6.7	10.9	7.8	5.4	31.9
PHQ-9 total	**24.5**	**33.9**	**23.4**	**12.1**	**6.1**	**100.0**

Source: YOU Student Wellbeing Survey. Based on Figure 2. N = 1,483.

[9] This proportion closely approximates the third identified for adults in same categories by Lee and Oguzoglu (2007: 3) from the HILDA survey and Huppert and Whittington (2003) based on the Health and Lifestyle Survey (HALS) which were answered by adults in England, Scotland or Wales during 1984 to 1985.

Figure 2 and Table 1 show that low psychological distress is not automatically accompanied by high well-being. Nearly a quarter of students (1.5 + 21.2 percent) are exceptions, although less than two percent (1.5 percent or 23/1483) reported experiencing moderate and high subjective well-being *as well as* moderate-severe to severe psychological distress over the same two reference weeks. In the more common off-diagonal experience, 21.2 percent reported low or low-moderate well-being alongside minimal or mild ill-being.[10]

While the cut-points are useful in identifying different categories of student mental health, their interpretation depends on how the cut-points or thresholds are defined. As Doll pointed out, both their position and number can, "mask the complexity that marks the interrelations among psychopathology and subjective well-being" (Doll, 2008: 71). And, as Eklund et al. observed in their study of university students, "individuals' functioning may be better described as existing along a continuum." (2011: 89), a point echoed by Renshaw and Cohen (2014:332). We recognise these two points in identifying latent clusters of the students' scores on the two screening instruments.

4.1 Latent profile analysis

In contrast to traditional, non-latent clustering methods such as K-means clustering and hierarchical clustering, latent profile analysis (LPA) treats profile membership as an unobserved categorical, latent class or cluster to which individuals are assigned based upon membership probabilities estimated directly from the model. The variables themselves may be continuous, categorical (nominal or ordinal), counts or any combination of these (Spurk et al., 2020). Our application of LPA combines well-being and ill-being indices into clusters based on their relative value.

We opted for a six-cluster model even though the LPA did yield some better models regarding lower AIC (Akaike Information Criterion) and BIC (Bayesian Information Criterion), however those other models also had more clusters with similar parameters, leading to fragmented results that lacked meaningful conclusions.[11] The six-cluster model has the most potential for inference and, as it turns out, at least two other published applications of LPA using alternative indices of well-being and ill-being also result in six (or seven) clusters (Zhao and Tay, 2022 and Xiao, 2021).

The LPA model is as follows:

$$(1) \quad E\left(Y_{i,t}\right) = \alpha + \beta_{x_i}^{S} + \beta_{t}^{T} + \tau_{x_i,t}$$

where for the ith student, t is the question set, α is the intercept and the argument, $x_i = 1,\ldots,6$, with constraints $\beta_1^S = \beta_{PHQ}^T = 0$, $\tau_{1,t} = 0$ for all t, and $\tau_{x_i,PHQ} = 0$ for all x_i. The response variable $Y_{i,t}$ is the continuous indicator of well-being and ill-being for the ith student. The super-script S

[10] Comparisons of these bivariate distributions of mental health with other campus studies require care to ensure that like are being compared with like. One of the closest comparisons is likely to be with Duffy (2020) who also applied PHQ-9 to first year students in 2019 at Queens University, Canada. A comparison of the two samples, Queens (n= 1530) vs Victoria University of Wellington (n= 1,485) using a PHQ-9 cut-off of 10 (moderate and above) shows the Canadian percentage of 28 percent was noticeably lower than the 42 percent recorded in the New Zealand sample. The difference (Queens vs Victoria University) across the five PHQ-9 categories is as follows: Minimal 42.4% > 24.5%, Mild 30% < 33.8; Moderate 15.3%<23.4; Moderately severe 7.6% < 12.2% and Severe 4.6% < 6.1 (Duffy, 2020, Table 1, p. 3). On the basis of this evidence the first year students in New Zealand returned higher proportions in all ranges from mild to severe, leaving less than a quarter in the minimal category.

[11] AIC and BIC combined reflect how well the model fits the data with a term that penalizes the model in proportion to its number of parameters.

represents the student cluster effect (cluster 1 to cluster 6) and the super-script T represents the question set effect (WHO-5 or PHQ-9).

Using the finite mixture modelling approach, sampled students were clustered into six groups based on the similarity of responses to the two indices. Their cluster membership was obtained using the posterior probability of success. For example, if a student was allocated to clusters 1-6 with the probabilities (0.2, **0.4** 0.2, 0.1, 0.1, 0.0), the student was assigned to cluster 2 because it has the largest probability (0.4). The probability of belonging to each cluster was estimated for all students completing the baseline survey.[12]

Table 2. The mean well-being and ill-being scores of six clusters of first year university students, April 2019.

Cluster	Well-being	Ill-being
1	72.7	11.5
2	63.0	31.9
3	49.3	18.5
4	53.1	56.5
5	37.0	40.6
6	29.2	74.6

Source: YOU Student Wellbeing Baseline Survey

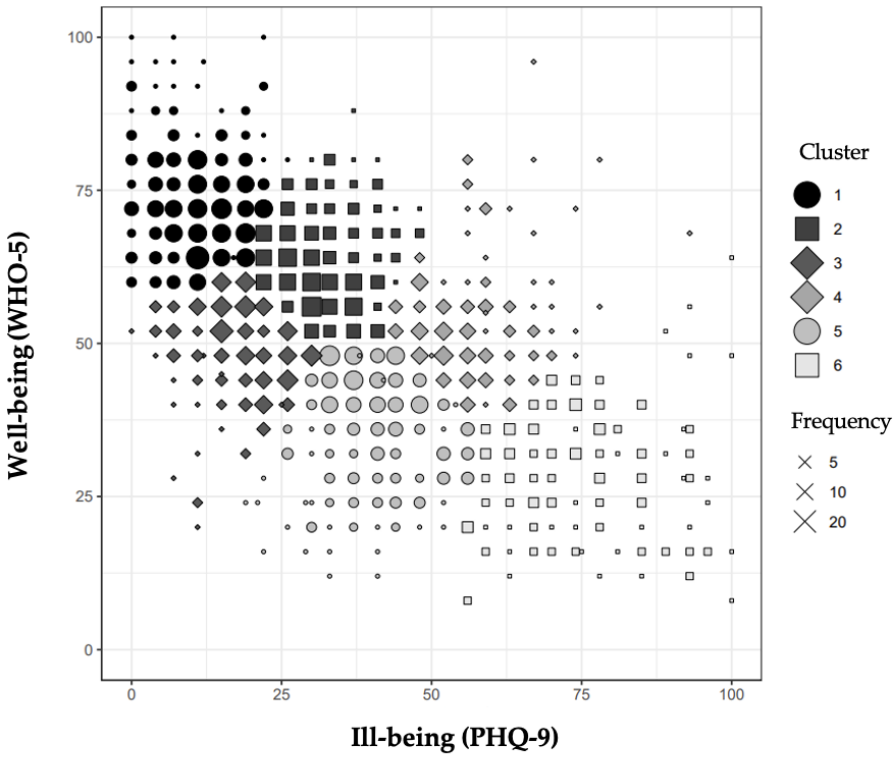
The results of the clustering are presented graphically in Figure 3. The position of each symbol within the plot reflects the intersection of the students' scores on the two indices at baseline. The symbols identifying each cluster also have different shading and differ in size (depicting groups of 5, 10 and 20 students). The twelve mean well-being and ill-being scores are listed by cluster in Table 2.

Students in the top left of Figure 3 (cluster 1) are clearly flourishing for they return an average well-being score of 72.7 and an average ill-being score of only 11.5. In contrast, students with a high probability of being in cluster 6 (bottom right of Figure 3) are languishing by comparison with a mean well-being score of only 29.2 and a much higher psychological distress score of 74.6. Four further clusters sit between those two extremes: cluster 2 for example sits above the implicit fitted regression line with an average well-being score of 63 and a mean ill-being score of 31.7 and cluster 3 sits below with a lower mean WHO-5 of 49.3 and a low PHQ-9 score of 18.5.

While identifying the way their students are distributed across various states of mental health is a first step, university administrators also want to know what generates their membership. Rather than go through a suite of possible influences, we focus on two policy relevant conditions - the students' assessment of their physical health and the degree to which they are able to meet their financial commitments, their financial health. We ask this question of the baseline sample as a whole, the panel, and then consider their role within each cluster.

[12] We used the *clustglm* package in R: https://github.com/vuw-clustering/clustglm (Pledger and Arnold, 2014).

Figure 3. Six clusters of first year university students based on their well-being and ill-being scores, April 2019.



Source: YOU Student Wellbeing Survey, 2019.

4.2 The influence of physical and financial health

We have long known that physical health is strongly affected by mental health status (Momen et al, 2020; Suldo et al., 2016, Ansari, et al., 2011, Veenhoven, 2008, Roberts et al., 2000), and that the reverse is also true (see Renshaw and Cohen, 2014, esp. Table 5 p. 327-8, Scott et al., 2016, 2018; Staudinger, 1999). The implicit assumption of the bipolar, single continuum model is of a monotonic negative well-being response to poorer physical health. The dual continua model on the other hand, opens up the possibility that both well-being and ill-being could respond differently to changes in both physical and financial health.

Our physical health question asked each first year university student: '*How is your physical health in general*''. Would you say it is, *1. Very Bad, 2.Bad, 3.Fair, 4.Good,* or *5. Very Good*? As expected, the cross-section baseline results show ill-being scores falling and well-being rising as physical health is judged more positively. The mean of the WHO-5 well-being score is lowest among students who judge their physical health to be Bad or Very Bad, 41.7 percent (+/- 2.36) and is highest among students who view their physical health as Good or Very Good, 59.2 percent (+/- 1.06). The PHQ-9 mean level of ill-being for students in Bad or Very Bad health averaged 53.9 percent (+/-3.04), greatly exceeding the mean of 26.9 percent (+/- 1.36) percent returned by students who said they are in Good or Very Good health.

Our second variable is the students' assessment of their financial capability which has also been shown to impact student mental health (Andrews and Wilding, 2004 and Denovan and Macaskill, 2017). For example, Richardson's longitudinal study of 454 first year British undergraduate students showed, "Greater financial difficulties predicted greater depression and stress cross-sectionally, and also predicted poorer anxiety, global mental health and alcohol

dependence over time." (Richardson, 2016: 344). In a contemporary UK study McCloud found that, less income, more loan income, more total expected debt and experiencing more financial difficulties were all associated with more symptoms of depression in students (McCloud, 2022). At the same time, interesting distinctions have emerged between the mental health consequences of the constant quest to meet daily expenses (Jessop et al, 2008 and Joo et al, 2008) and the effects of long-term debt (Cooke et al, 2004).[13]

The finance question we ask in the YOU survey reads: "*Over the past six months, I have had difficulty in meeting my financial commitments*". 1. *Strongly disagree*, 2. *Disagree*, 3. *Neutral*, 4. *Agree*, 5. *Strongly agree*. Our baseline survey showed that the 49.3 percent (+/- 1.77) who agreed or strongly agreed was much lower than the 56.3 percent (+/- 1.08) of students who said they disagreed or strongly disagreed.

In order to quantify the association physical and financial health have with well-being and ill-being at baseline we apply the following two multiple regression models.

(2) $W, I = \alpha + \beta^{P} + \beta^{F} + \beta^{PF}$,

where W and I refer to well-being and ill-being respectively. On the right-hand side of the equation 2, α is the intercept, β^{P} is the coefficient indicating how much W or I changes when the student records a higher or lower level of physical health (P), β^{F} is the coefficient of the corresponding difference in financial capability (F), and β^{PF} reports the effect of their interaction (PF). In the regression, responses to the physical health question have been collapsed into Bad (10.7 percent of the baseline sample), Fair (36.4 percent) and Good (53 percent), and responses to the finance question have been grouped into Disagree (58 percent), Neutral (21.2 percent) and Agree (21.4 percent).[14]

The post-estimated margins from the two regressions in equation 2 are shown in Figure 4 together with their 95 percent confidence intervals, with Fair and Neutral as the respective bases. The well-being effect of being in better physical health is positive as expected (Figure 4a). The mean well-being of students ranges from 38.1 percent when their physical health was Bad to 57.6 percent when reported Good. The main effects in both Figure 4a and 4b are statistically significant at $p < 0.01$ (although neither of those who simply disagreed with the finance question differed from the neutral base).

The two lines within each Figure 4 depict the response of students who disagreed and agreed they could not meet their financial commitments. Students who disagreed returned higher well-being and lower ill-being at each level of their self-assessed physical health. Well-being declined further when the student experienced both bad physical health and agreed they could not meet their financial commitments ($p < 0.1$); see Table S1 in supplement 2. The difference between those students in Bad and Good physical health was more strongly reflected in the students' ill-being than their well-being, as previous research has shown (Lee and Oguzoglu, 2007, Huppert and Whittington, 2003) and the contingent differences in financial health were also more marked in Figure 4b than in 4a.

In summary, our cross-sectional estimates show that the students' physical and financial health had a more marked quantitative and statistically significant effect on the students' ill-being

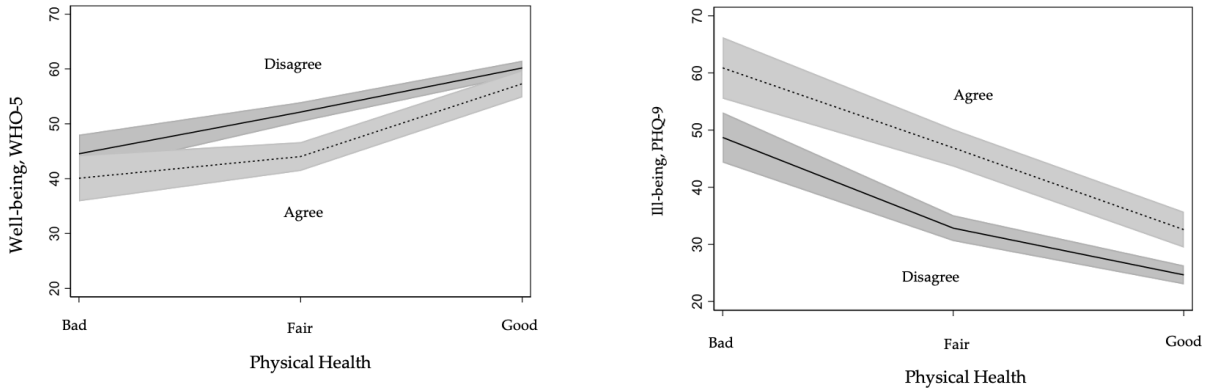
[13] Further research is needed to examine in more detail how lack of social, financial and material resources, and the associated limited action possibilities, lead to the emergence of poor mental health in young people (Holzkamp, 1992; Holzkamp-Osterkamp, 1991) a point made strongly by students themselves (New Zealand Union of Student's Associations, 2018) and in their submission to the New Zealand Mental Health Commission (Universities New Zealand (2019).

[14] The estimates table from the cross-sectional regression in equation 1 is available as Table S1 in supplement 2 and may be compared to the panel estimates shown below which are based on Table S2.

than their well-being, pointing to a degree of independence between the two mental health measures. At the same time, the baseline survey only allows us to identify *associations* between the two mental health measures and the students' physical and financial health. In order to advance a *causal* interpretation and thereby test the third, functional independence axiom on which the bipolar model rests, we need to be able to show that changes in the students' well-being and ill-being respond differently to changes in the students' physical and financial health. In other words, we need to be able to demonstrate that the dual continua model holds within students as well as between them (Kraiss et al, 2022).

Figure 4. The well-being and ill-being association with differences in physical health by those who agreed and disagreed they could not meet their financial commitments, April 2019

a. Well-being (WHO-5) n = 1,507 **b. Ill-being (PHQ-9) n = 1,477**



Source: YOU Student Wellbeing Survey

5. The panel survey

All the first year students at Victoria University of Wellington who completed the baseline YOU survey were invited to join a panel and complete a follow-up survey every six months for up to four years, resulting in a longitudinal sample of eight waves (although only the first two waves are used here).[15] Of the over fifteen hundred students who completed the baseline YOU survey in April 2019, 351 completed the first follow-up survey in September (a volunteer rate of 22.8 percent) and we refer to those as panel students. Although self-selected, panel students turned out to be representative of the baseline, at least with respect to the four variables used in the comparison: age, sex, school status and parental education (see supplement 1). The main difference between the baseline and the panel was the higher proportion of female students in the latter.

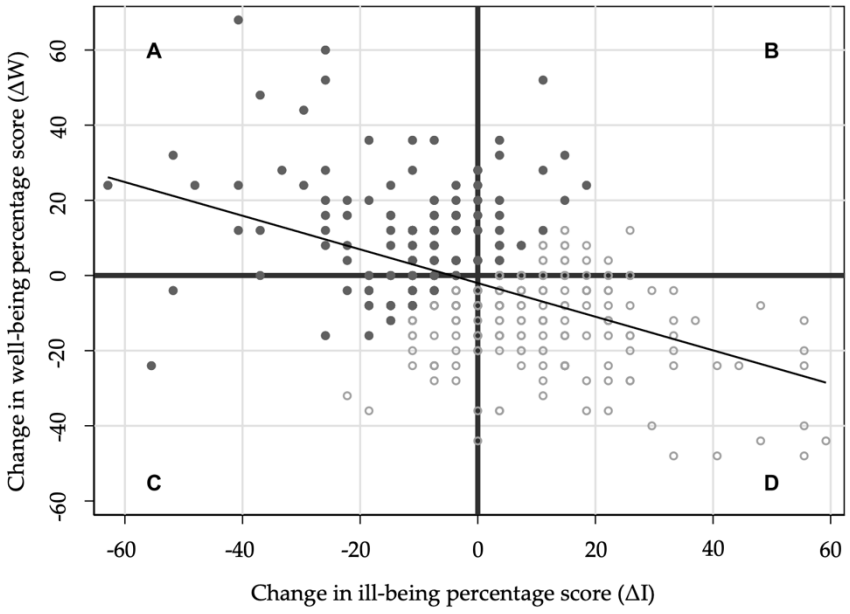
[15] Panel studies of university students remain quite limited in number, scope and duration (DuToit et al., 2022). The Canadian U-Flourish project concluded that, "Research to date has been limited by a lack of longitudinal studies, low response rates yielding non-representative samples, and the use of varied and not always validated measures." (Duffy 2020:1). Earlier applications include Cooke et al. (2006) and Bewick et al. (2010). Most panels of students only cover a single time interval, see for example Williams and Smith, (2017), Rubin, Evans and Wilkinson (2016), Denovan and Macaskill (2017), Friedlander et al. (2007) and (Duffy et al, 2020). Studies covering four waves are fewer in number: Beja and Yap, (2013), Yu, et al., (2018), and Shek (2017) and the 11 wave Australian study by Cvetkovski et al., (2017) appears unique. New Zealand studies (of graduates) include Winter et al. (2021) and (of selected disciplines) Leahy et al. (2010). For a recent study based on UK Student Academic Experience Surveys covering multiple years see Sanders (2023). So far, at least two studies have examined the way the well-being and ill-being dimensions of their dual-factor model behaved over time, DiLeo (2022) in a three -wave model and Xiong (2017).

As the 2019 academic year progressed the mean well-being of our first year students declined and their average ill-being rose, mirroring a common finding in the university student wellbeing literature (see for example. Berwick, 2010, Fisher and Hood, 1987 and Duffy et al, 2020). The panel students' mean WHO-5 percentage score fell from 52.83 in April to 50.04 in September 2019, a statistically significant decline ($p< 0.001$). Their mean PHQ-9 percentage score experienced a corresponding rise, from 32.93 to 34.43, a difference (from a slightly smaller sample) that was only statistically significant at $p < 0.09$. The difference in the corresponding medians of the two measures was zero in both cases.

The panel students' first six months of study was reflected in the *net* changes they experienced in their mental health, that is, the degree to which the change in their well-being was matched by the change in their ill-being. At the same time, these net figures hide a considerable variation in their components across the panel sample as shown in Figure 5. The most telling counter to the bipolar model occured when participants experienced an increase in their ill-being as well as their well-being, or alternatively experienced a reduction in both (Mason Stephens et al, 2023:1). The solid vertical and horizontal lines in Figure 5 separate the gains and losses in well-being and ill-being by the panel. Net gains in mental health appear as open circles and identify those students whose gain in well-being exceeded the decrease in their ill-being. Closed circles denote the reverse.

The regression of the students' six month change in well-being on their change in ill-being is plotted as the continuous 'diagonal' line in Figure 5. The statistically significant regression coefficient of less than unity (-0.448, SE= 0.045) indicates that well-being fell less than ill-being implying a greater persistence in well-being over time, a feature also observed by Lee and Oguzoglu, (2007). A feature in support of the dual-continua model is the fact that changes in the two measures are only weakly correlated; only 21.4 percent of the variance in the change in well-being could be accounted for by the students' change in ill-being.[16]

Figure 5. Components of net change in panel students' well-being and ill-being between



[16] One of the reasons for the strong inverse relationship in Figure 5 is the wide distribution of points along the main diagonal (quadrants A and D). By contrast the points in cells C and B when the two are inversely correlated are relatively tightly clustered near the centre. For a discussion of the limitation of the Pearson correlation coefficient and the relative benefit of contingency tables in understanding such distributions, see Schimmack (2001).

April and September, 2019.

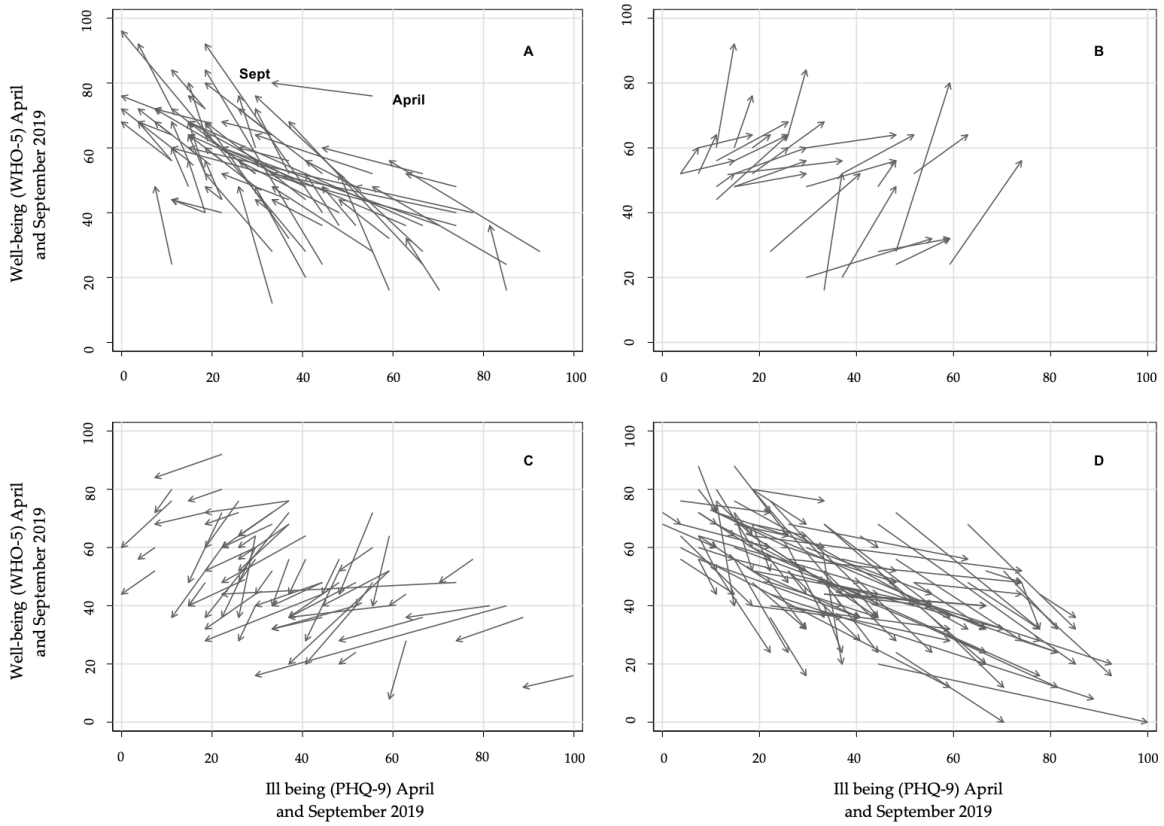
Source: YOU Student Well-being Panel survey.
Regression: $\Delta W = -2.00 - 0.448\ (0.046)\ \Delta I$; adj.$R^2 = 0.214$, N = 351

In summary, while the net change in well-being over the students' first six months of study was negative, their rise in ill-being was negligible, highlighting the fact that the rise/fall in negative emotions do not necessarily coincide with the fall/rise in positive emotions. We are left therefore with the conclusion that the dual continua model also applies to changes *within* students as well as between them. However, a very diverse set transitions lie behind these net changes, as we now show.

5.1 Transitions between pairs of well-being and ill-being scores

The transition between pairs of scores which panel students returned, firstly at baseline and then in the follow-up survey, can be depicted as an arrow running from their April scores to their September scores (as labelled in quadrant A in Figure 6). The four graphs that make up the figure show there are a variety of paths that can lead to a given net change in a student's mental health.

Figure 6. Non-zero changes in well-being ($\Delta W \neq 0$) and ill-being ($\Delta I \neq 0$) between April and September 2019.



Source: YOU Student Well-being Panel survey

Each of these transition arrows can be viewed as a gross change from one state of mental health to another. Labelling the origins of the pair in April as W_a, and I_a and their destinations in September as W_s, and I_s, allows the differences to be expressed as $\Delta W = W_s - W_a$ and $\Delta I = I_s - I_a$. The difference between the changes in the two indices is the net improvement in mental health,

(∆ W - ∆ I). The slope of each arrow in Figure 6 reflects the ratio of the six month change in the students' well-being relative to their change in ill-being (∆ W/ ∆ I). The direction of the arrow (+/- ∆ W/ +/- ∆ I) indicates whether the respective change was positive, as anticipated by the bipolar model, or negative as accommodated by the dual- continua model. The length of each transition arrow indicates the magnitude or degree of change in the two pairs of scores. As Figure 6 shows, these transitions are typically longer when there is an inverse relationship between well-being and ill-being (quadrats A and D).

In summary, we included a panel sample in our research design in order to measure the *net* change students experience in their well-being and ill-being over their first six months of study (Figure 5). Our presentation of the *gross* changes that underlie the net changes highlight the underlying diversity in mental health among first year students (Figure 6). The two figures illustrate the presence of both positive and negative correlations between the changes (∆ W and ∆ I) and are a telling counter to the bipolar, single continuum model. Our panel survey also allows us to control for the time-invariant characteristics of students while we investigate time variant effects of change in the students' physical and financial health.[17] These characteristics are of interest in their own right but they can also be used to test the functional independence axiom (Cacioppo, 1994) as we now show.

5.2 The mental health impact of changes in student physical and financial health

The results from the first two waves of the student panel allow us to express equation 2 in change form as equation 3. Instead of assessing the influence of *differences* in levels of physical and financial health as we did using the cross sectional baseline returns, we now assess the mental health impact of *changes* in the panel students' physical and financial health, that is whether their respective levels of health declined, remained stable or improved over their first six months of study.

$$(3) \quad \Delta W, \Delta I = \alpha + \beta^{Change\ in\ P} + \beta^{Change\ in\ F} + \beta^{Change\ in\ P\ x\ Change\ in\ F}$$

The dependent variables, ΔW and and ΔI denote the change in the students' scores on the same instrument. On the right hand side, α is the intercept, $\beta^{Change\ in\ P}$ indicates how much the student's well-being and ill-being scores changed if they experienced a negative or positive change in physical health, and similarly for a positive or negative change in financial capability $\beta^{Change\ in\ F}$. The effects of the joint or interacted change are given by the estimate for $\beta^{Change\ in\ P\ x\ Change\ in\ F}$

The same question was asked of the students physical and financial health in wave 1 and 2, in September 2019 as in April. As noted above, the five categories of physical health, Very Bad through Very Good, were collapsed to Bad, Fair and Good. The difference between the answers in April and September were then classified as Decreased, Stable and Increased. As also noted above, the five responses to the finance question of Strongly Disagree through Strongly Agree then collapsed into to three: Agree, Neutral and Disagree and the changes categorised as Decreased, Stable or Increased.

[17] There are two components to these observed changes. The first is the disturbance when measured objectively, as when a doctor might observe a deterioration in a student's physical health. The second is the students' subjective interpretation of that objective change. The objective and subjective need not be of the same magnitude or even sign (Morrison, 2019). Most surveys of affected populations only capture the latter, the subjective, which introduce the additional measurement error of common method bias (CMB) (Podsakoff et al,2012). Although we recognise the potential for CMB in this paper we implicitly assume the subjective and objective are positively, if not perfectly, correlated.

Before we inspect the results of the regressions it is important to note the limited period over which we are assessing change and the limited scope that provides for changes in the students physical and financial health. For example, Table 3 shows that in the six months between April and September 2019, over three quarters of students in the panel reported no change in their physical health and over two thirds reported no change in their financial position.

Table 3. Changes in the students' physical and financial health over the first six months of study, n_p= 364.

Frequencies

	Financial health			
Physical health	Decrease	No change	Increase	Total
Decrease	12	30	10	**52**
No change	40	197	39	**276**
Increase	4	24	8	**36**
Total	**56**	**251**	**57**	**364**

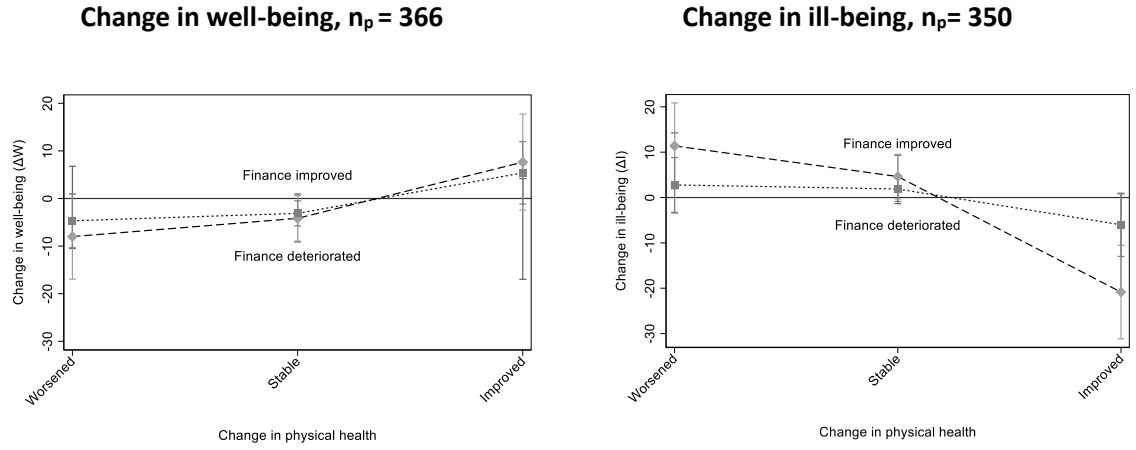
Cell probabilities

Financial health			
Decrease	No change	Increase	Total
0.03	0.08	0.03	**0.14**
0.11	0.54	0.11	**0.76**
0.01	0.07	0.02	**0.10**
0.15	**0.69**	**0.16**	**1.00**

Source: YOU Student Wellbeing Panel Survey, wave 1 and 2, 2019.

The estimates from the regression model in equation 3 and their post-estimated margins in Figure 7a show that changes in the students' physical or financial health had only a limited statistical effect on their well-being.[18]

Figure 7. The influence of changes in physical and financial health on well-being and ill-being scores in April and September, 2019.



Source: YOU Student Wellbeing Panel Survey.

The first panel of Figure 7 shows that those students who could meet their financial commitments and whose physical health increased over the six months were less likely to have experienced a decline in well-being and even experienced an increase. Those whose physical health *and* ability to meet their financial commitments improved saw their well-being improve over the base by 14.1 percent (relative to no change in either their physical or financial health), but as Table S2 shows, the estimate of the change parameter was only statistically significant at $p<0.1$. In fact, as the estimates table in the supplement shows, very little of the change in well-being experienced

[18] The estimated behind the margins plots are reported in Table S2 in the second supplement.

by students in the panel could be statistically explained solely by changes in their physical and financial health.

The influence of change in the students' health was registered more clearly in their ill-being, in PHQ-9 (the second panel of Figure 7), but again only one of the coefficients in the inter-active model of equation 2 proved to be statistically significant. When the students' physical health improved their level of psychological distress fell by 13.9 percent ($p < 0.05$) relative to the base, as shown in Table S2. The margins plots in Figure 7 depict the change in *predicted* well-being and ill-being percentage scores based on the estimates reported in Table S2.

In summary, in contrast to the influence of physical and financial health on student well-being and ill-being in cross-section, the statistical significance of *changes* in the two health variables was much weaker (albeit for a smaller sample over a limited time interval). While an improvement in the student's physical health over the first six months of study helped reduce the average rise in ill-being, any significant rise in well-being required a joint improvement in both physical health and financial capacity. Although limited, these different responses to well-being and ill-being to changes in physical and financial health are inconsistent with the precepts of the bipolar model. They can however be accommodated within the dual-continuum alternative.

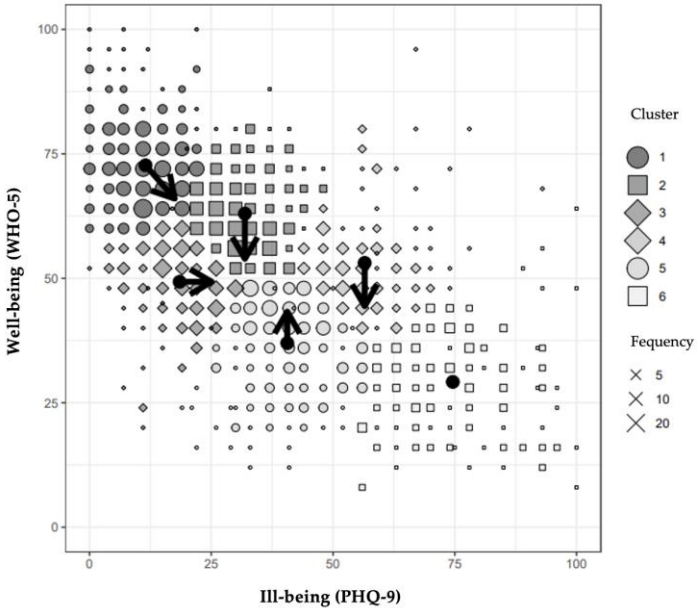
5.3 Changes in well-being and ill-being within clusters

The results of the panel survey were based on changes experienced by the student panel as a whole. While one might assume that these results were common to students in each of the clusters, this was not the case. The six clusters ranged from those containing students who were flourishing (high well-being and low ill-being) through to those who were languishing (low well-being and high ill-being) as shown in Figure 3. In order to test for homogeneity in responses across the clusters we estimated equation 3 separately for each cluster. Their membership ranged between 35 students in cluster 4 up to 85 in cluster 1.

The results are presented graphically in Figures 8, 9 and 10 and the corresponding parameter estimates and standard errors are shown in Tables 4, 5 and 6. The super-imposed arrows connect the intersection of the clusters' mean well-being and ill-being in wave 1 and wave 2, that is between April and September. Since the clusters are created from the baseline sample the starting points for each arrow remain the same in each of the following three graphs. For visual clarity, only the effect of *improvements* in financial health have been graphed.

Figure 8 depicts the experience of those students whose self-assessed physical and financial health remained stable between April and September 2019. The arrows therein show that students in cluster 1 returned relatively high well-being scores at baseline but experienced a decline in well-being as the academic year unfolded (-6.7 percent), while their psychological distress increased by 6 percent (Table 4). Meanwhile those in cluster 2 experienced a decline of 9.1 percent in average wellbeing without a statistically significant change in ill-being. The experience of those in cluster 3 was different again - they experienced no statistically significant drop in well-being but did record a rise in ill-being of 6.6 percent. In the absence of any change in physical or financial well-being the fall in well-being and rise in ill-being was consistent with the experience of the panel sample as a whole, varying only slightly according to the cluster the students were probabilistically assigned to in April, 2019.

Figure 8. Significant changes in mean well-being and ill-being in clusters when students reported no change in their physical and financial health between April and September 2019.



Source: YOU Student Wellbeing Panel Survey.

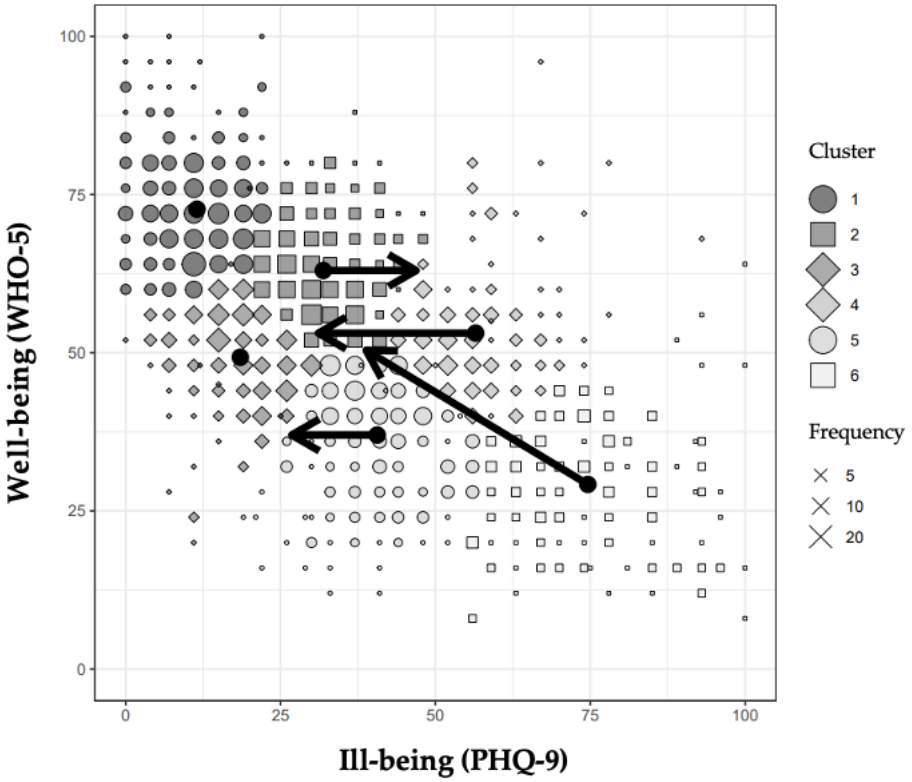
Table 4. Statistically significant estimates and their confidence intervals when Δ Physical = 0 and Δ Financial = 0.

Cluster	$\Delta(Physical)$	$\Delta(Finance)$	$\Delta(Well-being)$	$\Delta(Ill-being)$
1	*no change*	*no change*	-6.7 ± 2.9	6.0 ± 2.7
2	*no change*	*no change*	-9.1 ± 3.0	
3	*no change*	*no change*		6.6 ± 3.5
4	*no change*	*no change*	-8.7 ± 4.2	
5	*no change*	*no change*	6.3 ± 4.6	

Source: YOU Student well-being panel survey April to September, 2019

The difference between clusters became more marked when students experiencing changes in physical health alone were considered (Figure 9). A counterintuitive result was returned by those in cluster 2 whose mean level of psychological distress increased (right facing arrow) but with no apparent change in their mean well-being. This result could reflect their more robust mental health at wave 1 compared to those who began with low levels of psychological distress and, as a result, had less capacity for improvement. The remaining arrows in Figure 9 matched expectations more closely; the psychological distress of those with lower well-being reduced following improvements in their physical health. Those students in cluster 6, who we characterised as languishing in Figure 1 and 2, experienced the most marked improvement both in their well-being and their ill-being when their physical health improved.

Figure 9. Significant changes in the mean well-being and ill-being of clusters when only the physical health of students improved.



Source: YOU Student Wellbeing Panel Survey.

Table 5. Statistically significant estimates and their confidence intervals when Δ P> 0.

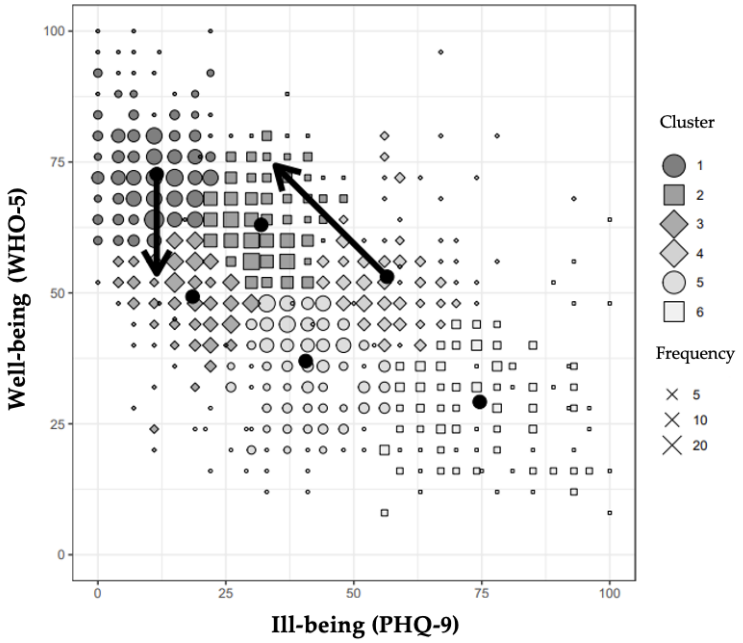
Cluster	$\Delta(Physical)$	$\Delta(Finance)$	$\Delta(Well-being)$	$\Delta(Ill-being)$
2	*increase*	*no change*		15.0 ± 12.3
4	*increase*	*no change*		-25.4 ± 23.9
5	*increase*	*no change*		-13.8 ± 12.0
6	*increase*	*no change*	21.2 ± 10.9	-35.8 ± 12.0

Source: YOU Student Wellbeing Panel Survey, 2019.

Figure 10 depicts the panel students' response to changes in their financial capacity when they expressed no change in their physical health. Those in cluster 3 showed a positive response, with a rise in well-being and an accompanying decrease in ill-being. However, those in cluster 1 experienced a 19 percent decrease in well-being with no change in ill-being. The (ungraphed) reduction in financial capacity within the same cluster with no accompanying change in physical health was accompanied by a fall in well-being, as anticipated (Table 6).

The improvement in financial capacity experienced by students in cluster 4 was associated with a 21.2 percent rise in well-being and an almost equivalent reduction in ill-being of 21.8 percent. The un-graphed decrease in financial capacity was also accompanied by an increase in ill-being as shown in Table 6, line 3. Finally, when it came to students experiencing a change in both their physical and financial health, only one statistically significant result was recorded which was for cluster 2 where members experienced a net 20.7 percent rise in ill-being.

Figure 10. Significant changes in the mean well-being and ill-being of clusters when only the financial health of students improved.



Source: YOU Student Well-being Panel Survey superimposed on the benchmark template, 2019.

Table 6. Statistically significant estimates and their confidence intervals when Δ F> 0.

Cluster	$\Delta(Physical)$	$\Delta(Finance)$	$\Delta(Well-being)$	$\Delta(Ill-being)$
1	*no change*	*increase*	-19.0 ± 7.9	
1	*no change*	*decrease*	-11.6 ± 7.5	
3	*no change*	*decrease*		19.5 ± 7.2
4	*no change*	*increase*	21.2 ± 10.9	-21.8 ± 14.5

Source: YOU Student Well-being surveys: Baseline and Panel, 2019.

In summary, not only did the students well-being and ill-being indices respond differently to both differences and changes in physical and financial health in cross-section and over time respectively, but the direction and magnitude of their responses also depended on the mental health cluster to which they were probabilistically allocated in the latent profile analysis. This variation in response of the two instruments across the clusters is an indication of the additional heterogeneity in the student panel sample over and above that demonstrated in favour of the dual continua model.

6. Discussion

For more than two decades those with a close working knowledge of universities have expressed concern over the mental health of their students and there is now an international consensus over the growing pressure young adults face when they enrol in their first degree. Most universities running surveys of students on campus apply single scale screening instruments which imply bipolarity. The purpose of our paper has been to show that well-being and ill-being are not

always inversely correlated but can be jointly present in students both cross-sectionally and over time. In so doing, we are responding to Antaramian's call for more evidence on the applicability of the dual continua model to college students (2015: 421).

Using a large survey of first year students in New Zealand we have shown that while the assumption of an inverse correlation of well-being and ill-being on campus has some support, it is not particularly strong. Not only do a proportion of students report both high well-being *and* high ill-being over a two-week reference period but many more record low scores on both screening instruments. We also find that students' well-being and ill-being exhibit functional independence by responding asymmetrically to changes in their physical and financial health over time.

Our results highlight the fact that measures of well-being do not predict levels of psychological distress very well (and visa versa), and therefore that instruments that only measure well-being or ill-being are unlikely to serve as reliable guides to the distribution of student mental health across campus. This is important both diagnostically, because of the range of interventions that could be undertaken and in terms of the resources which may be required to provide adequate pastoral care to students at different locations on the 'map' of mental health presented in Figure 2.

A particularly important consequence of implicitly employing the bipolar model is the reduced ability to design and introduce interventions needed to meet the needs of those students who return high scores on both well-being and ill-being scales, those who appear cheerful and in good spirits for example but also admit to feeling down, depressed or hopeless. An even larger proportion according to Figure 2 return low levels of psychological distress but do not produce complementary positive assessments of their own well-being. They may deny feeling tired or having little energy but also fail to agree they felt active and vigorous for example.

These apparent inconsistencies are not confined to the university campus. Their revealed presence in the wider population is now driving the OECD's own promotion of the dual continua model to countries, to member governments so they might better monitor the mental health of their population (using the same two instruments we have applied above, the WHO-5 and PHQ-9) (OECD, 2023).

A logical extension of recognising the dual continua is the attention now being paid to the separate (as well as overlapping) determinants of well-being and ill-being and how they might differ by student characteristic such as their gender, age, personality, resilience, and personal values among others. Also of interest is the way particular sets of well-being and ill-being scores relate to those outcomes of special interest to universities such as academic achievement, retention and completion (see Duffy and Keown-Stoneman, et al, 2020).

As we have illustrated in the case of changes in the students' physical and financial health, there is considerable scope for examining the impact of a range of micro level shocks on well-being and ill-being, such as changes in accommodation, relationships with fellow students, teachers and family. A recent example of macro level events is the arrival of COVID-19 in early 2020 which we have already begun to explore both methodologically (Liu and Morrison et al, 2023) and substantively (Morrison, 2022). At the same time, we are a long way from assembling a comprehensive model of student mental health, and the way it changes over their course of study and why. As both Campbell et al., (2022) and Duffy et al., (2020) argue, the addition of distal (family history and early adversity) and proximal risk factors (sleep problems, low self-esteem, reduced social support etc.) will be necessary. Most of these and other relevant questions are asked in the YOU survey but their incorporation into a comprehensive model of student mental health will continue to take time and resources to apply (see supplement 1).

7. Limitations

Notwithstanding its contributions, the present paper does have a number of limitations, both substantive and methodological. We have only investigated first year university students entering one university in one country in one year. While we plan to compare the two subsequent student cohorts from the YOU survey (2020 and 2021), any comparison with other universities and countries will have to draw independently on what is now a fairly deep, global literature on university student mental health.

A second limitation is the implicit assumption that we have at our disposal the necessary measures to classify students in terms of their mental health. Although the joint use of the WHO-5 and PHQ-9 is an advance, they are unlikely to be sufficient. There is likely additional value in incorporating general anxiety disorder questions as well as those which measure life satisfaction, both of which have been collected in the YOU survey.

Thirdly, we have tried to avoid overcomplicating our initial analysis by just focusing on two major influences on students' mental health, their physical health and financial capability. They are both domains over which the university and the state have a capacity to address. Both have an influence in cross-section, but the first six months of study considered above may be too early to judge the extent of their influence over time. Additional controls need to be added in cross-section and in the panel in order to address many other moderating influences such as loneliness, sub-standard accommodation, and the commute. Such intervening events, and shifts in conditions on and off campus, will be addressed later in our analysis of the 2020 and 2021 cohorts and subsequent waves of the panel in each case.

Finally, on the methodological side, while the latent profile mixture model offered a flexible and powerful way of modelling student heterogeneity, its application assumes that there are actually distinct groups in the student population. Because the presence of clusters is an *a priori* assumption the mixture model does not actually test hypotheses about the existence of discrete groups (Masyn, 2013: 607). We therefore remain careful not to reify the latent classes we have identified. What our application in the content of the dual continua model has allowed is a suggestion that they might exist.

Conflict of interest statement

The authors report no conflicts of interest.

Data availability statement

N/A.

Author contributions statement

Philip S. Morrison, Chair of the YOU Student Wellbeing project, proposed the idea of developing a multidimensional measure of student mental health by interacting the well-being and ill-being responses and testing their properties against the dual continua model. Ivy Liu suggested and developed the cluster methodology and Dylon Zeng undertook the coding for the latent profile analysis, created the cluster graphics and prepared their initial interpretation. All three authors were engaged in the editing and revisions.

Supplementary information

The supplementary file may be found on the publisher's website.

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Appendix 1. WHO-5 and PHQ-9 survey questions

The five WHO-5 questions refer to the last two teaching weeks prior to the survey. The statements are:

1. I have felt cheerful and in good spirits.
2. I have felt calm and relaxed.
3. I have felt active and vigorous.
4. I woke up feeling fresh and rested.
5. My daily life has been filled with things that interest me.

Each question is answered with a score ranging from 0 (at no time) to 5 (all of the time). Numeric answers to each question are summed for each student to yield a maximum total score of 25 which is then normalised, (converted to a percentage scale) by multiplying by 4. For example, a total score of 20 is rescaled to 80 percent ($20/25 * 100 = 80$). For further details see Bech (2004).

The PHQ-9 questions also refer to the two teaching weeks prior to the survey. The nine statements are:[19]

1. I have little interest or pleasure in doing things.
2. I feel down, depressed, or hopeless.
3. I have trouble falling or staying asleep or sleeping too much.
4. I feel tired or having little energy.
5. I have a poor appetite or over-eating.

[19] For a comprehensive summary of these two instruments see OECD, 2023: PHQ-9 p73-74.and WHO-5 p. 78 -79.

6. I feel bad about myself - or that I am a failure or have let myself or my family down.
7. I have trouble concentrating on things.
8. I move or speak so slowly that other people could have noticed.
9. I have thoughts that I would be better off dead, or I hurt myself in some way.

Students were asked to respond to each question with a score ranging from 0 (not at all) to 3 (nearly every day). The maximum possible total of 3 * 9 = 27 is used to construct the percentage. For example, a total score of 20 would be 74.07 percent of the maximum (20/27) * 100 = 74.7). Because the WHO & PHQ scores are multiples of 4 and 5 respectively, multiple individuals may share the same scores (which is why we separate them graphically by jittering the scatter). Applying the formula assumes all students answer all nine questions. For incomplete responses, the total score is rescaled accordingly

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