Decomposing the Transdiagnostic Nature of Future-oriented Mental Process: Associations of Future Self-Connectedness and Future Self-Valence with Mental Illnesses

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Abstract

Future-oriented concepts have been shown to link to various mental illnesses. Given the tendency for mental illnesses to co-occur, and enhancing future-oriented mental process and functions are adopted as intervention strategies, there is a necessity to better understand the specific links between the dimensions of future-oriented mental process and general versus specific mental illnesses. This study was among the first to examine the transdiagnostic and disorder-specific associations between future self-connectedness/self-valence and mental illnesses. Bifactor analysis was utilised in z-proso wave 8 data (N=1180, age=20), the two core dimensions of future mental process. Bifactor analysis was based on the mental illness structure identified via a calibration and validation approach, which was suggested as the optimal operation. Symmetry bifactor analysis yielded insufficient support for a p-factor, therefore, further analyses were explored and an S-1 bifactor analysis achieved the best model fit. In a structural equation model, S-1 bifactor model yielded evidence that future self-valence and self-connectedness both negatively correlated with internalising, ADHD, psychosis-like symptoms, and substance use. These findings supported transdiagnostic process and potential intervention strategies of these future-oriented dimensions. However, they were associated via separate paths with ADHD, internalising symptoms, psychosis and substance use, rather than via a shared psychopathological process.

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an S-1 bifactor analysis achieved the best model fit. In a structural equation model, S-1 bifactor model yielded evidence that future self-valence and self-connectedness both negatively correlated with internalising, ADHD, psychosis-like symptoms, and substance use. These findings supported transdiagnostic process and potential intervention strategies of these future-oriented dimensions. However, they were associated via separate paths with ADHD, internalising symptoms, psychosis and substance use, rather than via a shared psychopathological process.

Keywords : Future time perspective, future self-connectedness, future self-valence, bifactor, transdiagnostic factor

Late adolescence and early adulthood represent a critical developmental period marked by the transition to independence and the acquisition of skills necessary for navigating societal dynamics autonomously. Pivotal for this transition is the mental process that relates to projecting oneself into future plans and goals/values, maintaining an optimistic attitude towards the future, and thus adjusting present actions to approach these future aspirations to maintain self-coherence. Characterised by "a general concern for and corresponding consideration of one's future" (Kooij et al., 2018, p. 869), these future-oriented mental process, despite being conceptualised variously in literature (Mohammed & Marhefka, 2019; Shipp et al., 2009), was suggested to be generally encompassed as part of the broad "future time perspective" concept (Kooij et al., 2018). More importantly, future-oriented mental process is a key aspect of the subjective sense of temporality, which is the inherent nature of how we perceive life experiences and the sequential flow of consciousness that shapes our sense of self (Seligman, 2016). Because of its importance in the fundamental experience of human consciousness, temporality also plays a role in the manifestation of symptoms in mental disorders. Thus, future-oriented mental process, as a key aspect of temporality, is essential for diagnosing, interpreting, and treating mental illnesses from a phenomenological and intervention perspective (Moskalewicz, 2016).

Future time perspective is multi-dimensional and can be decomposed into sub-dimensions, such as orientation (i.e., the ability to think about the future), continuity (coherence/connectedness) and affectivity/valence (Kooij et al., 2018), and can reflect different contents. It is thus insightful to examine how transdiagnostic its critical dimensions on the core contents are and how they link to certain specific mental illnesses. Future self-continuity, a core concept of future-oriented mental process more specifically focused on the subjective representation of self at the meta-cognition level (Kooij et al., 2018; Lysaker et al., 2020; Mohammed & Marhefka, 2019), is thus the focus of the present study, as it directly reveals the future self shaped by life experience (Seligman, 2016). It is defined as the subjective sense of connection between the present and future self (see review by Sedikides et al., 2023), and consists of dimensions namely imagination vividness of the future self, future self-valence (positive or negative), and the degree of connectedness between the present and future self, as revealed by its measurement tools (e.g., Hershfield, 2011; Sokol & Serper, 2020). Considering various terms used in studies on the same future time perspective topic we discussed, "future-oriented concepts" is employed when referring to the various terms, and future-oriented mental process is used when referring to the mental process described by these concepts.

Future-oriented concepts have been found to be associated with a range of mental illnesses but with varying levels of generality. For example, future time perspective, as the most inclusive concept, is negatively associated with depression and anxiety, substance use, risky behaviour (see meta-analysis by Kooij et al., 2018), ADHD (Weissenberger et al., 2020), personality disorder (Mostowik et al., 2021), bipolar disorder and schizophrenia and personality disorders (Oyanadel & Buela-Casal, 2014), PTSD (Papastamatelou et al., 2021), suicide (Laghi et al., 2009; Shahnaz et al., 2019), and compulsive behaviour (Unger et al., 2018). Future self-discontinuity is commonly shown in populations with depression, anxiety, stress, and suicidal ideation (Ball & Chandler, 1989; Sedikides et al., 2023; Sokol & Serper, 2017), and among psychiatric patients (45% with schizoaffective disorder and 38% bipolar disorder in a depress and/or manic episode) (Sokol & Serper, 2019), schizophrenia (Giersch et al., 2015), psychosis (Vogel et al., 2019), and depersonalisation disorders (Giersch et al., 2015).

However, these associations are scattered across separate studies that typically analyse individual relationships between future-oriented concepts and specific mental illnesses. Limited work has simultaneously examined various mental illnesses in relation to any future-oriented concepts. Given the strong tendency for mental illnesses to co-occur, analysing them separately makes it difficult to discern whether the observed links are disorder-specific or generalised. Individual associations may be confounded by co-occurring conditions, suggesting that future-oriented mental processes might only be indirectly associated with certain mental illnesses. Therefore, it is essential to distinguish between shared and unique variances in a single analysis when examining the relationship between time perspective and mental illnesses. Shared variance refers to common underlying factors contributing to multiple mental illnesses, while unique variance pertains to the specific aspects of each mental illness. By separating these variances, we can determine whether time perspective is linked to general mental illness factors or to specific disorders. Additionally, majority of existing studies, such as the studies summarised above, only shed light on future-oriented concepts as a whole. Breaking down the components or dimensions of future-oriented concepts holds promise for pinpointing precise associations between each dimension and particular type(s) or cluster(s) of mental illnesses. Through this approach, the essential elements of interventions tailored to specific disorder(s) or cluster(s) can be more accurately identified.

Critically, confirming the transdiagnostic nature of future-oriented mental process is significant in substantiating its therapeutical potential. Established therapeutic approaches have long recognised the importance of intervention strategies aimed at enhancing future-oriented mental process and functions. For instance, cognitive-behavioural therapy (CBT) addresses future-focused distortions such as catastrophising (valence) while emphasising future goal setting and planning (connectedness) (Roepke & Seligman, 2016). Similarly, acceptance and commitment therapy (ACT) integrates elements like 'dufusion' to target the valence of future experiences and self, while emphasises 'value' and 'committed action' (connectedness) toward future planning and goals (Hayes et al., 2006). In line with these approaches, Freeman et al. (2023) developed the Oxford Positive Self Scale (OxPos) to assess positive self-beliefs and their association with psychological well-being. Drawing on insights from 14 individuals with lived experience of psychosis, the scale was designed to evaluate cognitions closely linked to psychological well-being, particularly those amenable to psychological interventions. It was subsequently validated and developed a short version using a large, representative sample of 2500 individuals from the UK population, ensuring its broad applicability. Therefore, given the significance of future-oriented mental process in therapeutic interventions, understanding which mental illnesses are likely to be (more) responsive to interventions on which dimensions of future-oriented mental process is crucial for customising optimal intervention strategies. Therefore, considering the therapeutical strategies frequently target on the valence and present-future connectedness dimensions, our study specifically shed light on the future self-connectedness and future self-valence dimensions.

The bifactor model provides a statistical tool to help evaluate the links between general psychopathology, specific mental illnesses, and candidate transdiagnostic factors (Reise, 2012). All items from the mental illness questionnaire(s) included are used to define one general factor, named the p-factor, which represents transdiagnostically shared psychopathology across the mental illnesses examined. Each item also loaded onto one of the subfactors or 'group factors', which represent the specific mental illnesses with the shared variance partialled out. This identification of common shared psychopathology is especially useful in diagnosis and intervention, as it accounts for the clinical high rates of comorbidity. Notably, beyond the aforementioned evidence from cross-sectional analyses, longitudinal data analyses over decades suggest that the p-factor is associated with earlier onset, longer persistence, and greater cumulative diversity of mental disorders (Caspi et al., 2014; 2020). Therefore, if future self-connectedness or future self-valence is found to be associated with the p-factor, it indicates that this future dimension is a potential transdiagnostic factor.

However, the classical fully symmetrical bifactor modelling is only applicable if different facets (subfactors) of a construct (p-factor) can be considered interchangeable (Eid et al., 2017). Symmetry bifactor models often yield anomalous results, such as but not limited to nonsignificant, inconsistent, and/or negative subfactor variances and nonsignificant or negative factor loadings (Heinrich et al., 2020), which likely indicates no shared psychopathology. A review by Eid and colleagues (2017) found that 50 out of 82 published bifactor applications in psychology yielded such anomalous results. Many of these studies chose to omit a subfactor as the reference domain for the general factor to address inadmissible estimation, and/or released some factors from the bifactor structure and placed them alongside the 'general' factor at the same level within a structural equation model (Caspi et al., 2014; Romer et al., 2018). To address these issues, S-1 bifactor modelling was thus proposed by Eid et al. (2017), or called bifactor model with orthogonal p-free factors as later proposed by Casip et al.(2024). In this case, the 'general' factor in the nested bifactor structure is no longer a p-factor representing general psychopathology across all mental illness factors. Instead, it becomes a partially general factor, representing only a domain of mental illness(s) defined by its reference domain along with its subfactors. Consequently, many mental illness bifactor modelling studies evaluate an S-1 bifactor to overcome the difficulties of specifying a truly general p-factor across all mental illness subfactors (e.g., Haywood et al., 2021; Heinrich et al., 2021; Junghänel et al., 2020). This shifts the meaning of the general factor to a domain-specific shared factor characterised only by its reference domain and subfactors. Additionally, a calibration and validation approach is recommended to avoid potential pitfalls in bifactor modelling (Sellbom & Tellegen, 2019). Thus, this approach was adopted to ensure a well represented model structure.

Present Study

To the best of our knowledge, no previous study has examined distinctive associations of future-oriented dimensions with multiple mental illnesses using a transdiagnostic approach within a single inclusive model. Only one previous study analysed the transdiagnostic role of future orientation using a bifactor model (Yang et al., 2023); however, that study did not decompose the specific future-oriented dimensions (e.g., connectedness, valence), especially at the meta-cognitive level on future self (Lysaker et al., 2020), which may show differential links to mental illnesses and imply different intervention focuses. The primary goal of the present study was thus to use bifactor modelling to explore the transdiagnostic and disorder-specific associations between two critical dimensions of the future-oriented mental process—future self-connectedness and future self-valence—and various mental illnesses.

Methods

Participants

Participants were 1180 young adults (females = 48.1%, males = 51.9%) from the Zurich Project on Social Development from Childhood to Adulthood (z-proso). Z-proso is an ongoing multi-rater longitudinal observational study that builds on an earlier prevention and intervention study that began in 2004. The project has collected 9 waves of data on the participants from 56 selected schools so far. Participants initially enrolled in the project when they entered their first grade (aged 7). A stratified random sampling procedure, stratifying on school size and location was used to select the schools within Zurich, Switzerland. The data of the present study was extracted from the 8^{th} wave collection when participants were around 20 years old. The majority of the participants were born between May 1997 and April 1998, with 90% born in Switzerland. However, the majority of participants' parents (63%) were born outside Switzerland in one of over 80 different countries. Data collection was approved by the Ethics Committee from the [anonymised as requested]. Active informed consent was obtained from the youth themselves at age 20. Detailed information on z-proso regarding recruitment, sample descriptions, and measurements can be found in the study's cohort profile (Ribeaud et al., 2022) and in the data collection handbook (z-proso Team, 2024). The data and project materials can be accessed at: https://www.jacobscenter.uzh.ch/en/research/zproso/aboutus.html. Study analyses code and supplementary materials available at Open Science Framework: https://osf.io/8gqzh/?view_only=8fd5e53e7dab4b64bbb762cb625b08d1 [anonymised as requested]. The analyses of the present study were pre-registered at Open Science Framework: https://osf.io/czkdq/?view_only=7c65caf950c54158bcfac5af5b17b815 [anonymised as requested].

Measures

The commonly used assessment tool for future self includes only one item each for future self-connectedness and future self-valence (Ersner-Hershfield et al., 2009). This concise assessment was thus chosen considering the questionnaire length restrictions in a large-scale longitudinal cohort study.

Future self-connectedness : One item measured connectedness to the future self (Ersner-Hershfield et al., 2009). Participants were asked to select a pair of Euler circles (out of 7 pairs of increasingly overlapping circles) that represents how connected they feel to their future self in 10 years, with '1= not connected at all' and '7= completely connected'. In a previous study, test-retest reliability for connectedness over a two-week period was r =.66 (p <.001; a =.80) (Ersner-Hershfield et al., 2009).

Future self-valence : One item testing valence of the future self was drawn from The Self-Assessment Manikin (SAM) Measure Scales (5-point). The item asked for an evaluation of how positive or negative one feels about future self ('Which picture expresses how you feel about yourself in 10 years?') from 5 figures ranging from a smiling happy figure to a frowning unhappy figure. The SAM method has been effectively and extensively used to measure affective responses in a variety of studies (for details see the review by Bradley & Lang, 1994).

Social Behaviour Questionnaire (SBQ) : Mental illnesses were measured using the Social Behaviour Questionnaire (SBQ, Tremblay et al., 1991). Twenty-five items assessed externalizing behaviours, covering attention-deficit hyperactivity disorder (ADHD) symptoms, aggression (physical, indirect, instrumental/dominance, relation aggression), and conduct problems (stealing, lying, vandalism, and opposition/defiance), while twenty-three items measured internalising problems including anxiety, depression, self-harm, anger, and psychotic experiences (Murray, Eisner, & Ribeaud, 2017). A 5-point Likert-type scale was provided for item responses (1 =never, 5 =very often). The psychometric properties of the SBQ were investigated and reliability and validity (age 7 to 15) were supported in previous studies (Murray, Eisner, Obsuth, et al., 2017; Murray, Eisner, & Ribeaud, 2017; Murray et al., 2019).

Substance Use : Substance use data were collected in the z-proso wave 8. These items examined substance use over the previous 12 months on a 6-point scale from never to daily (never, once, 2 to 5 times, 6 to 12 times/'monthly', 13 to 52 times/'weekly', and 53 to 365 times/'daily'). Given that some illicit psychoactive substances were rarely reported as used by participants (e.g., for heroin only 1 participant reported usage), a threshold proportion of participants who used the illicit drugs and non-medical use of prescription drugs with substance use items in the analyses. This led to the final inclusion of 7 illicit psychoactive substances covering cannabinoid use with 2 items (i.e., cannabis/THC, cannabidiol/TBD), stimulant use with 3 items (i.e., ecstasy/MDMA, (met-)amphetamine, cocaine), hallucinogen use with 1 item (LSD, psilocybin, and other hallucinogens), and opioid use with 1 item (cough syrup or pastilles or drops with codeine) (Quednow et al., 2022; Schifano et al. 2018).

Analytical procedures

Given the goal of the present study was to examine whether future self-valence and self-connectedness would associate with a general p-factor representing transdiagnosric psychopathology, we first focused on developing a suitable p-factor model. To do this we adopted a calibration and validation approach in which exploratory factor analysis and confirmatory factor analysis were conducted on all the mental illness items. Calibration and validation are integral steps in the development and assessment of a measurement model, particularly in factor analysis, which was recommended by previous study as the optimal practice to avoid possible pitfalls (Sellbom & Tellegen, 2019). This approach incooperated with bifactor modelling was also recommended for studying transdiagnostic factors (Stanton et al., 2020). Calibration refers to the initial estimation of the model using a dataset, which is distinct from the one utilised for subsequent validation. This initial step involves exploratory factor analysis (EFA) to determine factor loadings, variances, and covariances while the next step of validation involves scrutinizing the generalizability and performance of the model in a separate dataset. Validation serves to assess the robustness and validity of the model beyond the original calibration data via confirmatory factor analysis (CFA). In our analysis, this apporoach was used to develop the latent structure for use in examining the associations between future self-connectedness/self-valence and mental illness. The sample was randomly split into two halves, to facilitate the development of a suitable model informed first by EFA in the first half, and then cross-validated using CFA in the second half. All analyses were conducted in R statistical software (Rosseel, 2012). Given the responses have a clear order but the distance between them is not uniform for the assessment iems (e.g., 1 =never, 5 =very often for SBQ), the data was treated as ordinal during the whole analysis process.

Exploratory factor analysis: A total of 66 missing values were observed across all 57 items and 1180 entries in the dataset. Given the missing rate (0.098%) of the data is less than 5%, which is considered negligible, and simple methods like listwise deletion or mean imputation can often be effective without introducing significant bias (Bennett, 2001; Schafer & Graham, 2002; Tabachnick & Fidell, 2013). Therefore, the mice package in R was utilized to perform multivariate imputation by chained equations, imputing missing data across five imputations (Buuren & Groothuis-Oudshoorn, 2011). The sjmisc package (Lüdecke, 2018) was further used to merge the multiple imputed data frames (5 imputed datasets) into a single data frame preparing for the EFA. The single data frame was also an adaptation to the parallel analysis in R, which does not support the pooling function of mice package for pooling the analysed results from each imputed dataset separately. Following this, parallel analysis and the minimum average partial test, and inspection of a scree plot were conducted to inform the latent factors for the included mental illness items, including both SBQ and substance use items. The unified criteria for identifying items to be included in the next step of CFA analysis were: 1) items with loading [?]|.03|; 2) cross-loading with both [?]|.03| was allowed and items with cross-loadings were assigned to both factors they were loaded on; 3) latent factors with fewer than 3 items were omitted due to such factors being poorly determined.

Confirmatory factor analysis: A CFA model adopting the structure developed by EFA was then conducted using the R software Lavaan package on the second half of the sample. The CFA model assumes the existence of seven latent factors and allows these factors to be correlated. Therefore, an oblique 7-factor confirmatory factor analysis (CFA) model was fitted. The diagonally weighted least squares (DWLS) estimator was used given the ordinal scale of most of the variables (Muthen & Muthen, 2017). Model fit was assessed using the comparative fit index (CFI), Tucker–Lewis index (TFI), the root-mean-square error of approximation (RMSEA), and the Standardized Root Mean Squared Residual (SRMR) (Hu & Bentler, 1999; Pavlov et al., 2021). Models were judged to fit well if meeting the conventional standards for good fit (CFI and TLI >.90; RMSEA and SRMR <.08).

Symmetry bifactor analysis: Based on the structure developed via EFA and cross-validated by CFA in the preceding stages, a bifactor model was then fitted. Here, all the items in the model are specified to load on both a general factor and one of the subfactors, while the general factor and subfactors are all forced to be orthogonal (Gibbons & Hedeker, 1992; Reise, 2012). Following this, both the general p-factor and the subfactors were further added to the model to correlate with future self-valence and future self-connectedness. Due to several items with a loading less than the conventional standard supplementary materials), as well as the substandard model fit (Table S4), alternative model analyses were also explored, including an SEM based on the CFA model, S-1 bifactor models, and separated SEM for subfactors.

S-1 bifactor analysis: A series of S-1 bifactor modelling were further carried out by releasing the subfactors with low loadings on the p-factor from the bifactor structure to explore a more optimal model structure (Eid et al., 2017). The reference domain was explored by adopting a subfactor with items loaded very high on the general factor in the bifactor structure during the exploration. The subfactors retained in the bifactor structure were still forced to be orthogonal to each other and the general factor. In contrast, the released factors and the general factor were treated as oblique and allowed to correlate with each other during analysis. Thus, a bifactor structure ”nested” within a CFA structure was constructed, forming the S-1 bifactor structure. The theoretical meaningfulness of the reference domain for the nested bifactor structure in the S-1 bifactor strucure was also considered.

SEM analyses: To examine the univariate associations between future self-connectedness/self-valence and mental illnesses, SEMs were also fit for each of the 7 subfactors separately.

To examine the links between future self-connectedness/self-valence and an multiple dimensions of mental illness (subfactors) simultaneously, several alternatiev approaches were used. First, an oblique CFA measurement model for the mental illness dimensions was used and each mental illness factor covaried with future self-connectedness and self-valence. This model is similar to the univariate models but allows for covariation between the mental illness dimensions.

Second, a bifactor model was used as the measurement model for the mental illness dimensions, with both the general and all specific mental illness subfactors allowed to covary with future self-connectedness and self-valence. Given that in the measurement model stages of analyses (see below), a symmetry bifactor model was shown to be a poor representation of the structure of the mental illness data, an S-1 bifactor model was used for the mental illness measurement model in the final bifactor SEM analyses. Both the general factor and sub-factors were allowed to covary with future self-connectedness and future self-valence.

Results

Exploratory factor analysis

Forty-eight SBQ items and 7 substance use items were analysed by EFA in the calibration half of the data (N =593). Parallel analysis results suggested 7 components, while the minimum average partial test (MAP) suggested 8 factors. The item loadings are provided in Table S1, with a cut-off point for salient item loadings of [?]|0.30|. Two items with loadings less than |0.30|, and factor 8 with only 2 saliently loading items were excluded from the CFA model in the next stage. Four items with cross-loadings were assigned to both the two factors they loaded on. This led to the selection of a 7-factor oblique structure containing 51 items. Six factors were consistent in content with the SBQ theoretical factor categories based on the pattern of highest loading items; therefore, these latent factors were labelled as internalising symptoms (e.g., 'felt worried', 'felt useless', 'felt alone', 'sad without reasons', 'felt like did everything wrong'), ADHD, physical aggression, reactive aggression, indirect and proactive aggression, and psychosis-like symptoms. The other factor was labelled 'substance use' as it comprised all the 7 substance use items.

The Pearson's correlation matrix based on the 7-factor structure was also calculated using the calibration sample (N=587), as shown in Table S3.

Confirmatory factor analysis

The oblique 7-factor model was then cross-validated in a confirmatory factor analysis model using the validation half of the data (N=587). The items of each of the 7 factors generated in the EFA model were assigned to load on the same factors but using the validation sample. The factors were assumed to be correlated thus a 7-factor oblique model was fitted. The results showed good model fit (Table S4) and salient item loadings for each of the factors as shown in Table S5.

Bifactor analysis

The symmetry bifactor modelling based on the CFA model in the previous stage was conducted by adding a general p-factor. The resulting model fit indices were not generally above conventional standards for good fit (CFI= .912, TLI= .904, RMSEA= .052, and SRMR= .096; Table S4). There also were estimation issues such as negative variances and many items did not significantly load on the p-factor (or a subfactor). Therefore, alternative models were examined, including the S-1 bifactor analysis for dealing with such common bifactor issues.

Following model modifications, wherein subfactors with substantial loadings were considered as parallel factors to the nested bifactor structure within a structural equation model, a series of S-1 bifactor analyses were explored. While the other alternalive options generated poor model fits and/or abnormal item loadings, a statistically more optimal and theoretically interpretable S-1 bifactor SEM model with 5 factors was derived. As depicted in Figure 2, an S-1 bifactor structure, with physical aggression as the reference domain and indirect and proactive aggression and reactive aggression as the first-level residual subfactors (Eid et al., 2017), was nested within a structural equation modelling (SEM) framework. This model structual is also meanful in interpreting its general G-factor, as the reference factor and its two subfactors are all the subclassifications of aggression. Its general G-factor was thus labelled the 'aggression' factor and was treated the same with the factors ADHD, internalising symptoms, substance use, and psychosis-like symptoms as the second-level factors in the SEM, indicating these factors had their own seperated psychopathology. As shown in Figure 2 and Table S8, all the items positively and significantly loaded on the aggression G-factor and other factors with the aggression factor and exceeded the conventional salient loading standard of 0.3, except for 3 items with slightly substandard loadings. The aggression G-factor took the physical aggression items as the reference domain, with indirect and proactive aggression and reactive aggression as the subfactors. This S-1 bifactor model was also theoretically meaningful.

The model fits of the final S-1 bifactor SEM were good and better than both the SEMs based on the symmetry bifactor model and the multifactor CFA oblique model, with CFI= .956, TLI= .952, RMSEA= .035, and SRMR= .069, as shown in table S4. We, therefore, adopted this as our optimal model for simultaneously modelling different domains of mental illness and used this to estimate the associations between future self-valence/self-connectedness and mental illness dimensions.

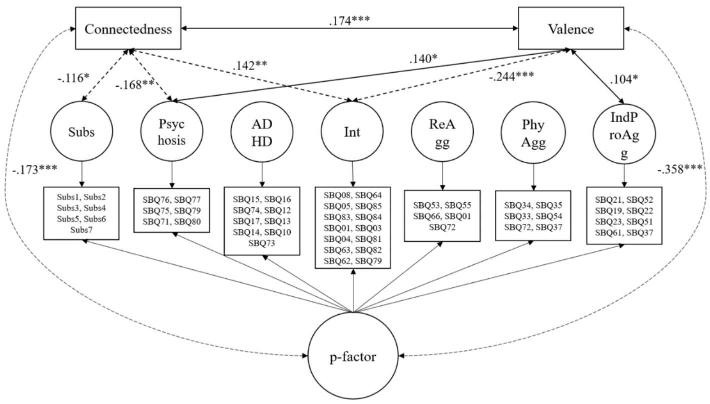
SEM models

Separate SEMs for subfactors: The model fits (Table S2) were all good and SEM results (Tables S9-S15) all achieved the related standards for each of the subfactor SEM. Future self-valence and future self-connectedness were negatively associated with all the subfactors in those separated single-factor SEMs except for physical aggression, and future self-valence was not associated with indirect and proactive aggression.

SEM based on the multifactor CFA oblique model: The results of the SEM based on the multifactor CFA oblique model achieved adequate loadings for all the factors except 2 items with cross-loadings. The model indices were above conventional standards (CFI= .954, TLI= .951, RMSEA= .036, and SRMR= .071). As shown in Table S6 and Figure 2: 1) future self-valence is significantly and negatively associated with internalising symptoms (r = -.430, $p < .01$, [95% CI = -0.504, -0.357]), ADHD (r = -.301,$p < .001$, [95% CI = -0.380, -0.222]), psychosis-like symptoms (r = -.220, $p < .001$, [95% CI = -0.326, -0.113]), reactive aggression (r = -.216,$p < .001$, [95% CI = -0.303, -0.129]) and substance use (r = -.143, $p < .01$, [95% CI = -0.246, -0.041]); 2) future self-connectedness is negatively associated with internalising symptoms (r = -.224, $p < .001$, [95% CI = -0.303, -0.144]), ADHD (r = -.151,$p < .001$, [95% CI = -0.231, -0.070]), psychosis-like symptoms (r = -.260, $p < .001$, [95% CI = -0.359, -0.161]), indirect and proactive aggression (r = -.133, $p < .01$, [95% CI = -0.230, -0.035]), reactive aggression (r = -.138, $p < .01$, [95% CI = -0.230, -0.047]) and substance use (r = -.166, $p < .01$, [95% CI = -0.265, -0.067]).

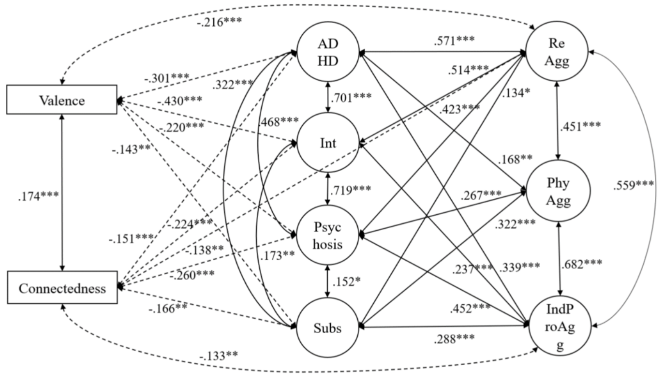
S-1 bifactor SEM: As noted above, we considered the S-1 bifactor model the optimal measurement model for mental illness, therefore, we gave the associations from this SEM the greatest weight as regards the multivariate links between mental illnesses and future self-valence and self-connectedness. These associations are provided in Figure 3 and Table S8. Future self-valence was significantly and negatively associated with the aggression G-factor ($r_{\text{aggression}}$ = -.125, $p < .05$, [95% CI = -0.223, -0.028]) and all 4 subfactors ($r_{\text{internalising}}$ = -.436, $p < .001$, [95% CI = -0.510, -0.362]; r_{ADHD} = -.301,$p < .001$, [95% CI = -0.380, -0.222]; $r_{\text{psychosis}}$ = -.220, $p < .001$, [95% CI = -0.327, -0.113]; $r_{\text{substance}}$ = -.143,$p < .01$, [95% CI = -0.246, -0.041]). In addition, future self-connectedness negatively associated with all the 4 factors ($r_{\text{internalising}}$ = -.226, $p < .001$, [95% CI = -0.307, -0.145]; r_{ADHD} = -.151, $p < .001$, [95% CI = -0.231, -0.070];$r_{\text{psychosis}}$ = -.260, $p < .001$, [95% CI = -0.359, -0.161]; $r_{\text{substance}}$ = -.166, $p < .01$, [95% CI = -0.265, -0.067]), but not with the G-factor representing aggression ($r_{\text{aggression}}$ = -.085, p = .084, [95% CI = -0.181, 0.011]). Further, future self-connectedness and future self-valence were positively correlated (r = .174, $p < .001$, [95% CI = 0.096, 0.252]).

Figure 1. Symmetry Bifactor SEM



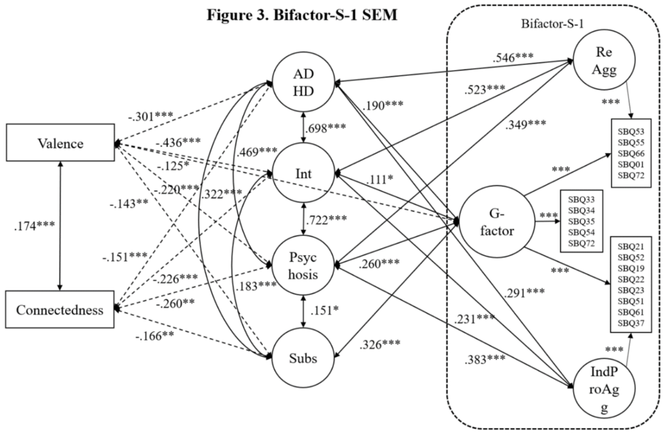
Note: Subs=substance use; Int=internalising symptoms; ReAgg=reactive aggression; PhyAgg=physical aggression; IndProAgg=indirect and proactive aggression.

Figure 2. SEM Based on CFA Structure



Note: Subs=substance use; Int=internalising symptoms; ReAgg=reactive aggression; PhyAgg=physical aggression; IndProAgg=indirect and proactive aggression.

Figure 3. Bifactor-S-1 SEM



Note: Subs=substance use; Int=internalising symptoms; ReAgg=reactive aggression; PhyAgg=physical aggression; IndProAgg=indirect and proactive aggression.

Discussion

The present study is among the first to examine the associations between future self-valence/self-connectedness and mental illness whilst accounting for the common covariation among mental illnesses. To explore the transdiagnostic and dimension-specific associations, we used a bifactor approach to explore the associations between general and specific mental illnesses and future self-valence and self-connectedness. In contrast to some previous research, a general p-factor was not sufficiently supported by a symmetry bifactor analysis. Therefore, we adopted an S-1 bifactor approach, of which fit indices suggested a better representation of the structure of the mental health data. Further, the structural equation models (SEM) using the S-1 measurement model and an oblique multifactor CFA model were consistent in suggesting that both future self-valence and self-connectedness are negatively associated with internalising symptoms, ADHD, psychosis-like symptoms, and substance use. Future self-valence and self-connectedness are also linked to some aggression factors. These results indicated a potential transdiagnostic protective role of these two future-oriented dimensions, but this was directly via each separated path with ADHD, internalising symptoms, psychosis and substance use, rather than via a shared psychopathological process represented by a full symmetry bifactor structure.

The present study provides some conceptual replications of findings in the area and extends them to offer several new contributions. First, both the future self-valence and self-connectedness dimensions were found to be negatively associated with internalising symptoms, which extends previous findings showing relations with general future-oriented concepts (Kooij et al., 2018; Sokol & Serper, 2017; Wang et al., 2022). Second, consistent with many previous studies (review by Sedikides et al., 2023), our findings suggest that low future self-connectedness and negative future self-valence could be the markers for psychosis-like symptoms. For example, in previous work schizophrenia and psychosis were associated with fewer positive and negative future events in general (e.g., Barry et al., 2020; Goodby & MacLeod, 2016). Deficit in future self-connectedness was associated with the severity of positive, negative and mood symptoms, and adaptive functioning capacity of patients with schizophrenia and psychosis (Sedikides et al., 2023), and was deemed as its core process accounting for these highly diverse symptoms (Mitchell et al., 2021).

Third, the present study specifically contributed to accumulating evidence on the association between negative future self-valence and self-connectedness with substance use. Previous studies have mainly focused on common substance use (e.g., alcohol, tobacco) or a mix of common and novel substance use (e.g., Kooij et al., 2018). Fourth, despite the large volume of studies on time perception/estimation in ADHD (Mette, 2023; Nejati & Yazdani, 2020; Ptacek et al., 2019), to the best of our knowledge, only a few studies so far have examined the association between ADHD and future time perspective (e.g., Weissenberger et al., 2016; 2020; Carelli & Wiberg, 2012; Settanni et al., 2018). No existing studies shed light on the relationship between ADHD and future self-connectedness or self-continuity. Our finding thus addressed this gap, showing a positive association between ADHD symptoms and future disconnectedness.

Future-oriented mental process is an important transdiagnostic factor to investigate because of their intervention potential. Crucially, previous research has suggested that future-oriented mental process is malleable. Except for the aforementioned strategies from cognitive behavioural therapy and acceptance and commitment therapy (Roepke & Seligman, 2016; Hayes et al., 2006), training with episodic future thinking is also evidenced as an effective strategy for improving future-oriented mental process (Rung & Madden, 2018; Schacter et al., 2017; Scholten et al., 2019; Ye et al., 2022). Cognitive bias modification (e.g., using dot-probe paradigm, ambiguous scenarios paradigm, word sentence association paradigm) could also target redirecting attention on or processing positive contextual cues about the future instead of other neutral/negative cues (e.g., words and pictures) that were previously more automatically processed (Jones & Sharpe, 2017).

Supported by these evidence-based intervention strategies, despite only cross-sectional data analyses being provided in the present study, several practical implications based on the present findings are still worth mentioning to provide some inspiration for future interventional research. As proposed by Roepke and Seligman (2016), future-oriented strategies (e.g., goal-setting and planning strategies from cognitive behavioural therapy) have strong potential in transdiagnostic treatments across mental illnesses. This claim is corroborated by one finding that high future self-connectedness not only mediated the links between job loss and negative affect (depression, anxiety and stress) (Levin et al., 2023), but also buffered between negative affect and healthy behaviour engagement (Kwan et al., 2023).

As regards substance use, repetitive rewards/reinforcement issues underlying dependency/addiction are a core symptom (e.g., DSM-5, ICD-11). Substances may provide more immediate reinforcement alternatives for accessing hedonistic feelings or escaping from negative feelings. Future-oriented intervention techniques could help to interrupt and redirect this dysfunction to adaptive function. For example, future goal-setting/aspirations and decision-making (between now and the future) are elements for increasing resilience against substance use in school training (Hodder et al., 2017) in some successful randomised controlled trial (RCT) intervention studies. In the RCT studies achieved positive results, “sense of purpose and future” and “goal monitoring” were used as elements in the career-oriented intervention (e.g., Griffin et al., 2009) on substance use; “life goal settings” was one of the intervention targets for preventing marijuana use (Eisen et al., 2003); challenging negative thoughts about the future was also used as an intervention element in a universal mental health promotion program addressing tobacco and alcohol use (Roberts et al., 2011).

Our findings also suggest that establishing a coherent temporal self and promoting positive future self images could be beneficial for psychosis. It has been proposed that impairments of synchronising inner time with external/social processes (Thoenes & Oberfeld, 2017) could account for the major symptoms of schizophrenia (e.g., delusions, thought insertion, cognition disorganization; ICD-11; DSM-5). This dysfunction of synchronising leads to fragmented momentary experiences, that fail to integrate into a coherent sense of temporal self-continuity/-connectedness (e.g., Berna et al., 2011; Fuchs, 2013; Giersch et al., 2015; Vogel et al., 2019; Vogeley & Kupke, 2006). Postmes et al. (2014) further postulate that hallucinations and delusions symptoms might be induced by subconscious attempts to restore perceptual coherence. Thus, training individuals experiencing psychosis to organize isolated personal experiences into a clear temporal sequence has the potential to serve as a comprehensive approach to addressing the diverse array of psychotic symptoms concurrently.

Finally, deficits in future-oriented mental process are likely part of the core symptoms of impaired time perception function (e.g., time estimation/ discrimination/ management/ reproduction) in association with ADHD symptoms (see reviews by Mette, 2023; Nejati & Yazdani, 2020; Ptacek et al., 2019). Training with positive future orientation and connecting the present self’s behaviours with future self outcomes (e.g., achieving personal goals) may provide practical strategies addressing the fundamental process of planning and time management, strengthening future-oriented mental process of ADHD (Mette, 2023).

Limitations and Future Directions

There are several limitations of the present study that should be noted. First, our measure of mental illnesses was selected based on the general community nature of the sample and is not a clinical diagnostic tool. In such sample, some symptoms may be relatively uncommon that may have negatively impacted analyses. Second, only one item was included for future self-connectedness and self-valence, respectively, due to the questionnaire length restrictions for a large-scale longitudinal cohort study. More items for each dimension can be considered in future studies. Third, there are different reference periods for different variables, despite the data being all reported in the same wave. For example, ADHD symptoms were reported concerning the past 12 months, internalising symptoms with respect to the past month, and future self-connectedness and self-valence items were worded about the situation/attitude at the moment (Kooij et al., 2018; Mohammed & Marhefka, 2019; Shipp et al., 2009). Future studies could replicate the findings using consistent time frames for all factors. Fourth, the present study used cross-sectional data and thus only correlations were explored due to the time frame consideration mentioned above. To solidify the intervention potential of improving future-oriented mental process to ameliorate mental illnesses, future research could design RCT intervention experiments or adopt a longitudinal analysis approach with multiple waves of data to assess the prospective relations between future-oriented mental process and mental health outcomes.

Conclusion

Our findings suggest that future self-connectedness and future self-valence dimensions were transdiagnostically associated with a range of psychological problems; however, there was a lack of evidence for a symmetry bifactor model suggesting that this is not mediated by a general unified pathway. Incorporating intervention strategies to improve future-oriented mental process may likely yield effective and efficient treatment and prevention for various psychological problems, including co-occurring problems. Our results also suggested customised treatment design would be the optimal clinical practice using the strategies targeting future-oriented mental process and functions.

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