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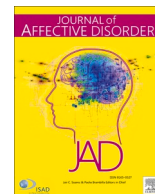
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Research paper

Meaning in life mediates the effects of sense of self and prosocial behaviours on anhedonia: A path analysis

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ABSTRACT

Background: Anhedonia, the loss of interest and pleasure, is a core symptom of depression that is resistant to treatment. Anhedonic young people describe a weakened sense of self and reduced meaning in life. Knowing if these experiences predict anhedonia could reveal novel targets for intervention development.
Methods: We recruited young people ($N = 429$, mean age: 20 years) with a range of depression scores. Using path analysis, we examined anhedonia, sense of self, meaning in life, and prosocial behaviours cross-sectionally and longitudinally at ~5-month follow-up ($N = 160$).
Results: Cross-sectionally, sense of self ($\beta =. 81$, $p < .001$) and prosocial behaviours ($\beta = 0.37$, $p < .001$) had direct effects on meaning in life, and meaning in life had a direct effect on anhedonia ($\beta = -0.11$, $p < .001$). Sense of self ($\beta = -0.09$, $p < .001$) and prosocial behaviours ($\beta = -0.04$, $p < .001$) had indirect effects on anhedonia, mediated by meaning in life. In the longitudinal analysis, sense of self at T1 had a direct effect on meaning in life at T2 ($\beta = 0.36$, $p < .01$) and an indirect effect on anhedonia at T2 ($\beta = -0.05$, $p < .01$), mediated by meaning in life.
Limitations: Approximately 70 % of the participants were female. Future studies should include equal numbers of males and females.
Conclusion: We provide novel evidence that targeting meaning in life, sense of self, or prosocial behaviours in psychotherapeutic interventions could be effective in alleviating anhedonia.

1. Introduction

A recent meta-analysis revealed that 34 % of adolescents globally, aged 10–19 years, are at risk of developing clinical depression (Shorey et al., 2022), and similar numbers of UK university students (31 %) experience depression symptoms (Rees, 2020; Jenkins et al., 2020). Depression onset in adolescence and young adulthood has a detrimental impact on normal development and leads to poorer outcomes later in life (Clayborne et al., 2019; Johnson et al., 2018). As approximately one third of young people with depression do not respond to treatment (Dwyer et al., 2020), new treatments are sorely needed.

Focusing on symptoms that are hard to treat could improve outcomes. Anhedonia, the reduced interest and pleasure in previously enjoyable experiences, is one of the main diagnostic criteria for depression. Anhedonia has been found to predict depression onset, persist into recovery (Hasler et al., 2004; Khazanov et al., 2022) and respond poorly to treatments (Kelly et al., 2022; McMakin et al., 2012). The latter seems to be partly due to a lack of focus on positive affect

among common treatments, which is a significant concern for those with pronounced anhedonia (Boumparis et al., 2016). Further, treatments designed to increase exposure to positive experiences do not always successfully improve anhedonia (Watson et al., 2020). Novel psychological treatments have emerged that aim to address this limitation, but evidence suggests that these treatments seem to be inadequate in targeting positive affect and ensuring long-term impact (Sandman and Craske, 2022). Thus, there is a pressing need for a novel treatment that effectively targets anhedonia.

Inconsistency in the definition and thus measurement of anhedonia has likely impeded novel anhedonia treatment development (Kaya and McCabe, 2019; Ma et al., 2024; McCabe, 2018; Rizvi et al., 2016). To improve the understanding of anhedonia, we conducted qualitative interviews with young people focused on their anhedonic experience (Watson et al., 2020). In the first study of its kind, young people described a lack of interest and pleasure, as might be expected, but also questioned their sense of purpose, agency and ability to see the bigger picture (Watson et al., 2020). These experiences are related to the

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concept of meaning in life (MIL), the perception that one's existence has significance, purpose, and coherence (Heintzelman and King, 2014). According to Frankl, meaning in life is a fundamental human drive, and focusing solely on happiness will eventually bring a meaning crisis (Frankl, 1985). High MIL has previously been found to be associated with decreased risk of depression and increased life satisfaction and happiness (Bergman et al., 2018; Li et al., 2019; Park et al., 2010; Sinclair et al., 2016; Steger et al., 2008b; Steger et al., 2009; Steger, 2018; Sun et al., 2021a; Xin-qiang et al., 2016). Further, MIL has been shown to be a protective factor against depression, stress and suicidal ideations, behaviours, and attempts (Costanza et al., 2019; Dulaney et al., 2018; Lew et al., 2020; Li et al., 2019; Sinclair et al., 2016). Numerous longitudinal studies indicate that lower MIL often precedes depression in adolescents and young adults (Dulaney et al., 2018; Disabato et al., 2017; Hadden and Smith, 2019; Lian et al., 2024; Shek et al., 2022). Additionally, having a sense of meaning and engaging in meaningful activities have been shown to elevate positive affect (Miao et al., 2017; Steger et al., 2008a; Machell et al., 2015) and to motivate individuals to engage in actions that amplify positive emotions (Disabato et al., 2017). Based on these findings, we hypothesised that lower MIL may predict anhedonia.

When describing their experience of anhedonia in our qualitative interviews, young people also questioned their sense of self and described feeling disconnected from others and the world around them (Watson et al., 2020). This finding extends the results of previous studies showing a reduced sense of self in those with and at risk for depression (Kopala-Sibley and Zuroff, 2020; Jones and Martini, 2021; Sokol and Eisenheim, 2016; Sokol and Serper, 2017). However, our study suggested that a weakened sense of self could be specifically related to anhedonia, not just depression more generally.

Although there has been a renewed interest in establishing a central role for altered perceptions of the self in depression (Davey and Harrison, 2022), little is known about the role of the self-experience in anhedonia. A reduced sense of self makes it challenging to recognize personal preferences and motivations that provide enjoyment (Malekzad et al., 2023), suggesting that it may contribute to increased anhedonia. In line with this notion, Grimm and colleagues (Grimm et al., 2009) described reduced activation in reward regions of the brain, such as the striatum, in response to self-related stimuli, which *could* indicate a connection with anhedonia, and a recent report found reduced *positive* learning about the self in depression (Hobbs et al., 2023). However, neither of these studies directly examined the symptom of anhedonia. We know of only one study in this area which found that, as anhedonia increased, there was a reduced perception of future self-continuity, i.e. a reduced sense of persistence of selfhood from the present to the future (Sokol and Serper, 2019). However, this study did not control for depression, which makes it difficult to determine whether the findings were specific to anhedonia. Using a novel scale we recently developed, the Multidimensional Sense of Self scale (MSoS) (Frey and McCabe, 2024), we found preliminary evidence for a reduced psychological sense of self (the sense of knowing oneself, including core characteristics, personality traits, and beliefs) and sense of self-continuity (feeling connected to oneself in the present and future through a stable self-concept over time) being associated with increased anhedonia in people with depression symptoms (unpublished data). However, these findings remain to be replicated in a larger sample. Based on the above reports, and the fact that a weakened sense of self has been observed in those at risk of depression, before symptom onset (Sowislo and Orth, 2013), we hypothesised that a reduced sense of self would (indirectly) predict anhedonia.

Further, previous research suggests that a diminished sense of self may also impede the ability to find meaning in life. Frankl states that each person has a unique life path to discover their meaning (Frankl, 1985) and knowing oneself, i.e. having a strong psychological sense of self, is needed before one can find this path (Wong, 2014). Earlier research indicates that a lower psychological sense of self and self-

continuity makes it difficult for individuals to define their goals and values, thus obstructing their understanding of the significance of their lives and their ability to perceive their life narrative (Carless and Douglas, 2008; Chu and Lowery, 2024; Flury and Ickes, 2007; Schlegel et al., 2009; Schlegel and Hicks, 2011; Shin et al., 2016). These are essential components of meaning in life (Martela and Steger, 2016). Therefore, taking into consideration the abovementioned relation between MIL and anhedonia, it is proposed that a weakened sense of self may contribute to reduced MIL, with the latter mediating the relation between sense of self and anhedonia (see a similar model in Hong et al., 2022).

Another important source for high MIL is shifting one's focus from self-centred interests to something greater and beyond one's individual self (Wong, 2014). This often manifests in prosocial behaviours, defined as "voluntary behaviour intended to benefit another" (Eisenberg et al., 2006), and could be an act of sharing, helping, taking care of, and feeling empathetic towards others (Caprara et al., 2005). Such behaviours have been associated with favourable effects on depression, life satisfaction, and wellbeing (Jenkinson et al., 2013; Tabassum et al., 2016) which are reported in youth over time (Memmott-Elison and Toseeb, 2022). Specifically, prosocial activities, such as spending money on others, volunteering, showing gratitude, and giving social support to others, have been linked to positive psychological outcomes (Doré et al., 2017; Klein, 2016; Schacter and Margolin, 2019; Van Tongeren et al., 2015). Giving to others, whether through support or money, has been associated with increased activation in reward regions (ventral striatum) and reduced depression symptoms a year later (Inagaki and Orehek, 2017; Telzer et al., 2014). Notably, some studies have found that prosocial behaviours are associated specifically with higher positive affect, rather than with lower negative affect (Raposa et al., 2016; Schacter and Margolin, 2019). This suggests a possible link between prosocial behaviour and anhedonia, which has not been widely examined. An exception is our previous study which found that participants who exhibited less prosocial behaviour demonstrated stronger social anhedonia symptoms (Setterfield et al., 2016). However, additional research is needed to further substantiate this finding.

The relation between prosocial behaviour and anhedonia may be mediated by MIL. It has been found that prosocial behaviours can promote virtues and foster actions and belief in a better world (Van Tongeren et al., 2015), and, thereby, increase MIL (Klein, 2016; Van Tongeren et al., 2015; Brestovanský et al., 2022). Those who feel less meaning often experience a need to engage in prosocial actions to increase their sense of meaning (Van Tongeren et al., 2015; FioRito et al., 2021). Thus, considering the abovementioned relation between MIL and anhedonia, we hypothesised that prosocial behaviours may help to alleviate anhedonia by increasing MIL.

Given the dearth of evidence regarding how the sense of self, MIL, and prosocial behaviours relate to anhedonia, as well as to each other, the current study aimed to elucidate these relations. Specifically, we conducted a path analysis to examine if sense of self, MIL and prosocial behaviours would predict anhedonia in young people with depression symptoms. As deepening an individual's awareness of their own sense of self can be a beneficial step towards finding MIL (Lutz et al., 2022; Schlegel et al., 2009; Schlegel and Hicks, 2011; Shin et al., 2016; Wilt et al., 2021) and prosocial behaviours are considered an antecedent of MIL (Brestovanský et al., 2022; Klein, 2016) we hypothesised that MIL would mediate the effect of sense of self and prosocial behaviours on anhedonia (see Fig. 1). Although previous findings suggest this hypothesised directionality, past evidence is not conclusive. Therefore, we also assessed a model where the directions were reversed, for comparison. Gaining a deeper understanding of the factors predicting anhedonia could reveal new targets for anhedonia and depression treatment development.
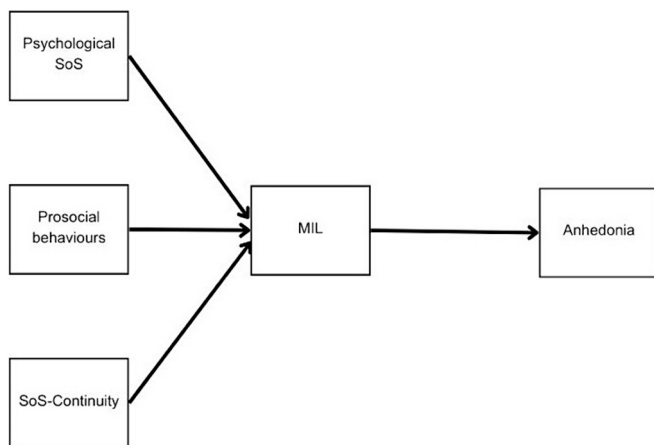
Fig. 1. Hypothesised path model: exploring the role of MIL as a mediator between sense of self (psychological and continuity), prosocial behaviours, and anhedonia. The model depicts direct effects with single-arrowed lines connecting independent and dependant variables.

2. Methods

2.1. Power

Using Fritz and MacKinnon's (2007) table for bias-corrected bootstrapping with 80 % power, we needed a minimum of 71 participants for the first mediated path (prosocial behaviours > MIL > anhedonia: 0.4 Cohen's d) and 115 participants each for the second and third paths (psychological SoS/SoS-continuity > MIL > anhedonia: HM: 0.3 Cohen's d), totalling 300 participants for the entire cross-sectional analysis.

We used the table provided by Pan et al. (2018) for sample size calculation of longitudinal mediation analysis. We need 160 participants in total to reach 80 % power; for an ICC of 0.8 with 2 observations and a medium effect size (MM), the required sample size using the bootstrap method is 80 participants for each part of the mediation path (Prosocial behaviours and psychological sense of self - > Meaning in life - > Anhedonia).

2.2. Participants

Young people ($N = 429$) between the ages of 16 and 25 years (mean age 20 years) with a range of depression symptoms were recruited from local schools and the student population via the School of Psychology research panel, online advertisements, and posters. Participants were reimbursed for their time and effort by being entered into a draw for a £50 Amazon voucher. When recruiting we asked participants whether they consented to being contacted for the follow-up survey. The 322 participants who consented to take part in the follow-up phase were contacted via email ~5 months after the initial data collection. Of these participants, 160 provided follow-up data. To reimburse their effort at follow-up, we entered participants into a further draw for one of five £20 Amazon vouchers.

All procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. The study was approved by the Research Ethics Committee (REC reference number: 2022–119-CM) of the Psychology Department at the University of Reading and written informed consent was obtained. Participants received a debrief form, which included contact details for the Samaritans and advised anyone concerned about their mood to contact their GP.

2.3. Procedure

This study utilized scale-based measures to examine the research questions. A link was provided to participants for the online information sheet and consent form. After reading the information sheet, participants had time to ask questions about the study via email. Subsequently, they completed the measures described below via Jisc online surveys.

2.4. Questionnaires

2.4.1. Depression

The *Mood and Feeling Questionnaire (MFQ*; Costello and Angold, 1988) is used to assess depression symptoms. It has been validated in clinical trials and is suitable for adolescents (Burleson Daviss et al., 2006; Jarbin et al., 2020). The scale consists of 33 items rated on a three-point scale (0 = not true, 1 = sometimes, 2 = true) and is one-dimensional, with higher scores indicating higher levels of depression symptomatology. Scores range from 0 to 66. In addition to its excellent internal reliability (Cronbach's alpha 0.91 to 0.93), the scale has sufficient validity and reasonable diagnostic accuracy, with clinical cut-off score of 27 (Thabrew et al., 2018).

2.4.2. Anhedonia

The *Anhedonia Scale for Adolescents (ASA,* Watson et al., 2021) was previously developed by our research group together with adolescents who are experiencing depression and anhedonia symptoms and was informed by qualitative interviews. The scale covers a range of components of the anhedonia experience relevant to this group. In total, it contains 14 items rated on a four-point scale (0 = never, 1 = sometimes, 2 = often, 3 = always), with higher scores indicating higher levels of anhedonia. Scores range from 0 to 42. The scale has excellent internal consistency (Cronbach's $\alpha = 0.93$) and good test-retest reliability (ICC = 0.73).

2.4.3. Multidimensional Sense of Self (MSoS)

The *Multidimensional Sense of Self Scale (MSoS)* (Frey and McCabe, 2024) is a 18-item scale previously developed by our research group. The scale consists of three subscales examining the *psychological sense of self* (e.g., 'I could easily describe what kind of person I am'), the *sense of self continuity* (e.g. 'It feels to me like I am a completely different person depending on the situation I am in.'), and *self-focused emotional processing* (e.g. 'I usually focus more on what is going on inside me (my thoughts and feelings) than on what is happening in the world around me.'). Each item is rated on a 7-point scale (1 = strongly disagree, 7 = strongly agree), with higher scores indicating a stronger sense of self. Subscale scores range from 6 to 42. The three subscales exhibit good internal consistency, as evidenced by Cronbach's α values of 0.83, 0.73, and 0.76, respectively. Moreover, the scale demonstrates strong test-retest reliability, with correlation coefficients of $r = 0.84$, $r = 0.80$, and $r = 0.82$, all of which are statistically significant.

The MSoS scale was selected for the present study because, compared to other available self-related measures, it best captured and separated the constructs we were interested in.

The psychological sense of self aligns with the concept of the reflective self, which involves self-awareness and understanding of one's traits, desires, and values (Klein and Gangi, 2010). It is related to the construct of the self-concept (Marsh and Shavelson, 1985), which encompasses the attributes, beliefs, and values an individual holds in relation to various dimensions of their life, such as academic, social, and other domains. However, the self-knowledge captured by the psychological sense of self does not just refer to the content of self-related beliefs, but also involves the individual's ability to access and be aware of the content. In this regard, the psychological sense of self is partially linked to self-concept clarity (Campbell et al., 1996), which refers to the extent to which self-beliefs are clearly and confidently defined, internally consistent, and stable (Campbell et al., 1996).

The sense of self-continuity relates to the temporal self, reflecting the perceived consistency of the self over time (Hu et al., 2016), as well as to the stability of the self-concept across different contexts (Markus and Kunda, 1986). A strong sense of self-continuity is thought to be associated with better mental health outcomes, as it provides a coherent and consistent sense of identity over time (Chu and Lowery, 2024; Diehl and Hay, 2011).

Self-focused emotional processing relates to the extent to which individuals focus on their inner emotional life, rather than on the external world, and to the emotional vividness they experience when remembering their own past or imagining their future. It is partially related to rumination in depression (Nolen-Hoeksema et al., 2008) but does not posit a particular valence of the content on which the processing is focused (i.e. the self-focused content could either be positive, negative, or neutral). For the present study, we chose not to examine self-focused emotional processing sub-scale as it is more closely related to depression and negative affect (Silvia, 2002; Mor and Winquist, 2002) than anhedonia. This has been confirmed by our previous findings in a different sample, in which higher anhedonia was significantly correlated with a weaker psychological sense of self and self-continuity, while no significant relation between anhedonia and self-focused emotional processing was observed (although the latter did correlate significantly with depression scores; unpublished data).

2.4.4. Meaning in life (MIL)

The *Multidimensional Existential Meaning Scale (MEMS)* was developed by George and Park (2016) and comprises 15 items related to what extent individuals feel a sense of coherence in their lives, are motivated by valued goals, and feel their existence is of significance. This scale consists of items related to comprehension (coherence and understanding regarding one's life), purpose (experience of one's life being directed and motivated by valued life goals) and mattering (feeling that one's existence is of significance, importance, and value in the world). A 7-point scale is used to rate each item (1 = very strongly disagree, 7 = very strongly agree), and higher total MEMS scores are indicative of a greater sense of MIL. Scores range from 15 to 105. Cronbach's alpha of the total scale is 0.89. We opted to include the total MEMS score, rather than subscale scores, in our path analysis, as we expected that the different MIL subconstructs would exhibit similar relationships to anhedonia and could, therefore, be analysed collectively. The latter was confirmed in correlation analyses conducted on our data (see Table S1).

2.4.5. Prosocial behaviours

The *Prosocialness Scale* (Caprara et al., 2005) contains 16 items assessing how often individuals engage in behaviours or experience feelings that fall into one of four categories: sharing, helping, taking care of, and feeling empathetic towards others (e.g. 'I try to help others'). The scale is unidimensional, and a Cronbach's alpha of 0.91 has been observed for the complete list of items. Each item is rated on a 5-point scale (1 = never/almost never, 2 = rarely, 3 = occasionally, 4 = often and 5 = always/almost always) and higher scores indicate greater prosocial tendency. Scores range from 16 to 80.

2.5. Data analyses

Data were analysed using SPSS 27.0 and SPSS Amos 27.0 (IBM Corp, 2020). Participant demographics were summarized using descriptive statistics, and associations between questionnaire measures were examined using Pearson correlation analysis.

Path analysis was used to estimate the strength and significance of relationships between the questionnaire measures, both cross-sectionally and longitudinally. We examined direct and indirect effects, obtaining insights into the complex interrelationships within our hypothesised model (see Fig. 1). Maximum likelihood estimation was used to estimate parameters. The hypothesised paths were evaluated by examining the unstandardized path coefficients and their associated

significance levels. The significance of indirect effects was assessed using bootstrapping with 2000 resamples to obtain bias-corrected confidence intervals (Fritz and MacKinnon, 2007). Statistical significance was set at $p < .05$.

The model goodness of fit was assessed using the chi-square statistic, the comparative fit index (CFI) (Bentler, 1990), the goodness-of-fit index (GFI) (Hair et al., 2010), the Tucker and Lewis (1973) index (TLI), the standardized root mean square residual (RMR) and the root mean square of approximation (RMSEA). Following recommendations from the previous literature (Hair et al., 2010), the cut-off values used in the current analysis to indicate that the path model demonstrated a good fit were (1) a *p*-value of the chi-square statistic >0.05; (2) a value of CFI, TLI and GFI > 0.9; (3) a value of RMR < 0.05 and (4) a value of RMR between 0.05 and 0.08.

For the cross-sectional path model, we initially tested the proposed model shown in Fig. 1, which included the following relationships: a) the direct effect of sense of self (psychological, continuity) and prosocial behaviours on meaning in life (MIL), b) the direct effect of MIL on anhedonia, and c) the indirect effect of sense of self (psychological, continuity) and prosocial behaviours on anhedonia, mediated by MIL. However, this model did not demonstrate an adequate model fit ($\chi^2/df = 13.51$, $p < .001$; *GFI = 0.97, CFI = 0.93; TLI = 0.75, SRMR = 0.06, RMSEA = 0.17*).

Modification indices suggested that a better model fit could be achieved by adding direct paths between the sense of self variables and anhedonia. While we expected this relation to be mediated by meaning in life, as indicated in the introduction, it could be a partial rather than a full mediation as there is some theoretical justification and previous evidence for this (Jones and Martini, 2021; Kopala-Sibley and Zuroff, 2020; Sokol and Eisenheim, 2016; Sokol and Serper, 2017). Therefore, we added the recommended direct paths to the model (Yaşlıoğlu and Yaşlıoğlu, 2020). The revised model is illustrated in Fig. S1.

In addition, in a second cross-sectional model, we added depression scores (as well as age, gender, mood medication, depression diagnosis) as covariates to the model's dependent variables, MIL and anhedonia. When controlling for depression we used the MFQ scores without the three anhedonia items: "I did not enjoy anything at all"; "I didn't want to see my friends"; and "I didn't have any fun in any of my activities" in line with anhedonia as a lack of interest and pleasure (Insel et al., 2010).

Moreover, in a third cross-sectional model, we explored the possibility that the relationships between the variables could be reversed. Although previous research supports the directionality proposed above, it cannot be ruled out that, higher levels of anhedonia might lead to a decrease in MIL, prosocial behaviours and sense of self. Consequently, the third model contained paths in the reverse direction of those originally proposed.

The longitudinal path model was constructed using a longitudinal panel mediation model with two waves (Hayes, 2022, p.570). Specifically, in the first longitudinal model, we investigated the following relationships: a) the direct effect of T1 prosocial behaviours and T1 psychological sense of self on T2 MIL, while controlling for T1 MIL and T1 anhedonia, b) the direct effect of MIL at T1 on anhedonia at T2, while controlling for T1 anhedonia, and c) the indirect effect of T1 prosocial behaviours and T1 psychological sense of self on anhedonia at T2, mediated by MIL.

In the second longitudinal model, we introduced T1 and T2 depression levels (as well as age, gender, mood medicate, depression diagnosis) as covariates to the model's dependent variables, MIL at T2 and anhedonia at T2.

And, in the third longitudinal model, we tested the reversed path model which included a) a direct effect of T1 anhedonia on T2 MIL, while controlling for T1 MIL levels and T1 prosocial behaviour levels and T1 psychological sense of self levels, b) a direct effect of MIL at T1 on prosocial behaviours at T2 and psychological sense of self at T2, while controlling for T1 prosocial behaviours and T1 psychological sense of self, c) an indirect effect of T1 anhedonia on prosocial behaviours and

psychological sense of self at T2, mediated by MIL.

All data were screened for missing values, outliers, skewness, kurtosis, and multicollinearity prior to analysis. For the cross-sectional data, there were three missing data points within the demographic information of one participant; one outlier was larger than ±3; and the co-efficients of skewness and kurtosis were within ±1.96. For the longitudinal dataset, there were no missing data, two outliers were larger than ±3, and the coefficients of skewness and kurtosis were within ±1.96. The Variance Inflation Factor (VIF) and collinearity tolerance values were well within acceptable limits (VIF < 5; tolerance >0.20; James et al., 2017) for both the cross-sectional and longitudinal data, indicating no significant multicollinearity concerns.

3. Results

3.1. Demographic characteristics

Participants had a mean age of 20 years and a broad range of depression and anhedonia symptoms (Table 1). Of the 429 participants in the sample, 18.2 % (*N* = 78) had a clinical depression diagnosis from their general practitioner, a psychologist, or a psychiatrist and 14.7 % (*N* = 63) of participants were on medications for their mood. Participants had a range of depression symptoms, with 50.6 % (*N* = 217) scoring >27 on the MFQ, which is considered a clinical level of depression, 26.1 % (*N* = 112) demonstrating a medium MFQ score between 15 and 27, and 23.3 % (*N* = 100) scoring <15 on the MFQ (Thabrew et al., 2018). Demographics for the subset of participants who were included in the longitudinal analyses, which were similar to those of the cross-sectional sample, can be found in the supplement (Table S2).

3.2. Correlation between questionnaire scores

Pearson correlation analyses were conducted on the cross-sectional

Table 1
Descriptive statistics and demographics of the participants (*N* = 429).

Descriptive characteristics	Mean (SD)	Range
Age	20.98 (2.29)	16–25
Depression (MFQ)	26.54 (13.91)	0–66
Anhedonia (ASA)	18.01 (8.12)	2–42
Psychological SoS (MSoS)	26.28 (6.38)	8–42
SoS-continuity (MSoS)	22.92 (5.94)	6–37
MIL (MEMS)	62.69 (15.10)	15–105
Prosocial behaviours (Prosocialness)	58.03 (10.75)	23–80

Demographic characteristics	n(%)
Gender	
Female	310 (72.26 %)
Male	102 (23.78 %)
Other	17 (3.96 %)
Ethnicity	
White - English, Welsh, Scottish, Northern Irish or British	176 (41.0 %)
White – Irish	40 (9.3 %)
White - Any other White background	56 (13.1 %)
Asian or Asian British	85 (19.9 %)
Black, African Caribbean or Black British	12 (2.8 %)
Arab & Turkish	21 (4.9 %)
Mixed or Multiple ethnic background	34 (7.9 %)
Prefer not to say	5 (1.2 %)
Clinical diagnoses of depression	
Yes	78 (18.2 %)
No	351 (81.8 %)
Mood medications	
Yes	63 (14.7 %)
No	366 (85.3 %)

Note. Abbreviation: SD, standard deviation; MFQ, Mood and Feeling Questionnaire; ASA, Anhedonia Scale for Adolescents; MSoS, Multidimensional Sense of Self Scale; MEMS, Multidimensional Existential Meaning Scale.

data (Table S3) and Bonferroni correction was applied to reduce the chance of a type I error. The analyses revealed that higher depression scores were associated with higher levels of anhedonia (*r* = 0.82, *p* < .001), and higher anhedonia scores were associated with lower sense of self (psychological, *r* = −0.46, *p* < .001, continuity, *r* = −0.27, p < .001), MIL (*r* = −0.58, p < .001,), and prosocial behaviour (*r* = −0.27, p < .001) scores (Fig. 2). Additionally, higher levels of MIL were associated with a stronger sense of self (psychological, *r* = 0.55, p < .001) and more prosocial behaviours (*r* = 0.41, p <. 001).

Furthermore, Pearson correlation analyses with Bonferroni correction for the longitudinal data (Table S4) demonstrated that higher depression scores at T1 were associated with increased anhedonia levels at T2 (*r* = 0.65, *p* < .001), and higher sense of self (psychological, *r* = −0.44, *p* < .001), and MIL (*r* = −0.54, *p* < .001) scores at T1, were associated with decreased anhedonia levels at T2. Additionally, we observed that a stronger sense of self (psychological, *r* = 0.55, *p* < .001) and more prosocial behaviours (*r* = 0.27, *p* < .001) reported at T1 were associated with increased MIL at T2.

3.3. Cross-sectional path analysis

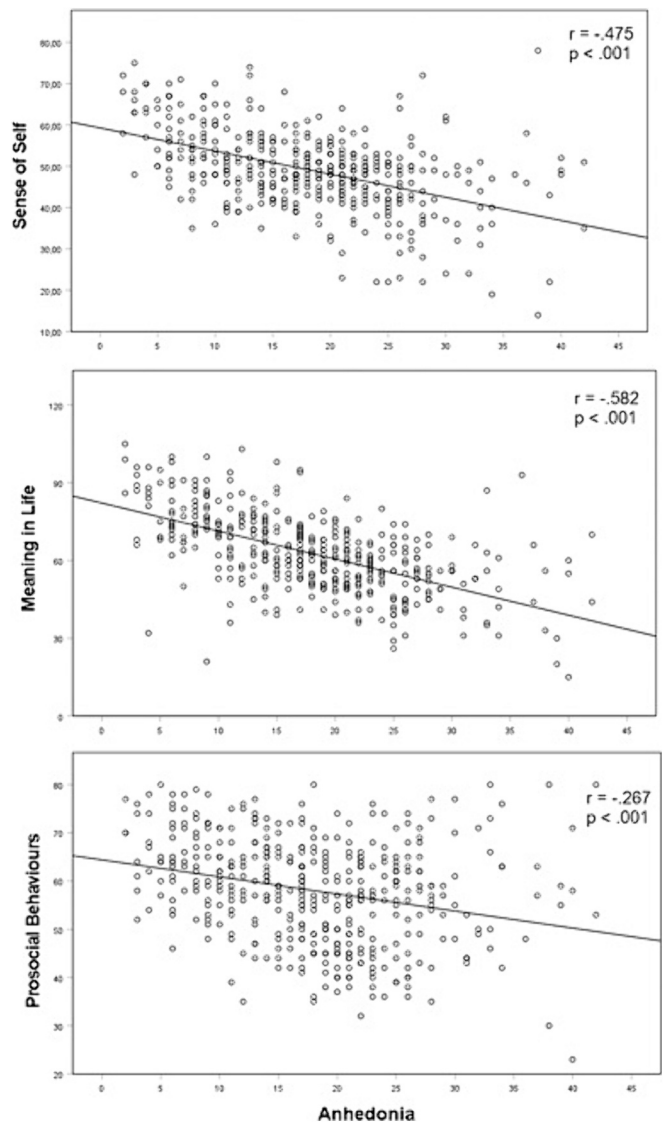The revised model (controlling for depression scores, age, gender,

Fig. 2. Comparative scatterplots illustrating the relationship of anhedonia with sense of self, meaning in life, and prosocial behaviours.

mood medication, depression diagnosis) (Fig. 3) demonstrated good fit: $\chi^2/df = 3.42$, $p > .05$; GFI = 0.998; CFI = 0.998; TLI = 0.912; SRMR = 0.006; RMSEA = 0.075. We found that MIL had a significant direct effect on anhedonia, while sense of self (psychological) and prosocial behaviours had a significant direct effect on MIL and significant indirect effects on anhedonia via MIL (Table S5).

The model explained 48 % and 68 % of variance within MIL (squared multiple correlation coefficients (SMC) = 0.48, $p = .008$) and anhedonia (SMC = 0.68, $p = .005$) respectively.

Results for the cross-sectional model that is not controlled for depression scores (see Fig. S1 and Table S6) and the reversed model (see Fig. S2) are reported in the supplement.

3.4. Longitudinal path analysis

The hypothesised longitudinal model (controlling for depression scores, age, gender, mood medication, depression diagnosis) (Fig. 4) demonstrated good fit: $\chi^2/df = 0.896$, p > .05; GFI = 0.991; CFI = 1.000; TLI = 1.007; SRMR = 0.022; RMSEA = 0.000. We found that psychological sense of self at T1 had a significant direct effect on MIL at T2 and a significant indirect effect on anhedonia at T2, mediated by MIL at T2 (Table S7). The effect of prosocial behaviour at T1 on MIL at T2 and the effect of MIL at T1 on anhedonia at T2 were not significant.

SMC coefficients indicated that the model explained 67 % and 80 % of variance within MIL at T2 (SMC =0.67, $p = .020$) and anhedonia at T2 (SMC = 0.81, $p =. 016$), respectively.

Results for the longitudinal model that is not controlled for depression scores are reported in the supplement (see Fig. S3 and Table S8).

We also tested the reversed mediation model, (controlling for depression scores, age, gender, mood medication, depression diagnosis) see Fig. S4 and Table S9). The results for the reversed model are also reported in the supplement. Even though the model fit was good, the direct effect of anhedonia T1 on MIL T2 and the indirect effects of anhedonia T1 on psychological sense of self at T2 and prosocial behaviour at T2 were not significant.

4. Discussion

In this study, we examined the relationship between anhedonia, MIL, sense of self and prosocial behaviours in a sample of adolescents and young people with depression symptoms, at two time points, using path analysis. We provide novel evidence that, cross-sectionally, anhedonia was directly predicted by MIL and indirectly by psychological sense of

Fig. 3. Path model controlled for depression, exploring the mediating role of MIL on the relationships between sense of self, prosocial behaviours, and anhedonia. Path coefficients between observed variables are displayed as unstandardized regression coefficients. Covariates: age, gender, clinical diagnosis, and mood medication. *p<.05, ***p<.001.

self and prosocial behaviours, via MIL. Additionally, MIL was directly predicted by psychological sense of self and prosocial behaviours. In the longitudinal analysis, we found that anhedonia at T2 was indirectly predicted by psychological sense of self at T1, mediated by MIL at T2, and that MIL at T2 was directly predicted by psychological sense of self at T1. These findings suggest that it may be possible to reduce anhedonia with treatments that improve MIL, e.g. by strengthening the psychological sense of self and prosocial behaviours.

4.1. Meaning in life

No studies have investigated MIL and anhedonia. Previous research has found that MIL is associated with reduced depression symptoms which could encompass anhedonia symptoms, but this is not clear (Bergman et al., 2018; Li et al., 2019; Park et al., 2010; Sinclair et al., 2016; Steger et al., 2009; Steger, 2018; Sun et al., 2021a; Xin-qiang et al., 2016). By directly examining MIL and anhedonia we found reduced MIL predicts greater anhedonia and mediates the effects of sense of self and prosocial behaviours on anhedonia, above and beyond depression. The effect of MIL on anhedonia could be explained by MIL's motivational component (Crego et al., 2021; George and Park, 2016; Martela and Steger, 2016), which drives people to attain valuable aims and persevere in meaningful behaviour despite potential obstacles (McKnight and Kashdan, 2009; Steger et al., 2008a; Steger, 2018). For example, it has been demonstrated that, when individuals perceive actions to have more significance and purpose, they may be more inclined to perform them (Crego et al., 2021). Further, finding meaning in leisure activities is associated with feeling more socially connected and more joyful (Iwasaki, 2008; Iwasaki et al., 2015), and this derived sense of meaning not only boosts positive affect (Miao et al., 2017; Steger et al., 2008a; Machell et al., 2015), but also motivates further actions that amplify these positive emotions (Disabato et al., 2017), all of which could potentially reduce anhedonia. Therefore, future studies could substantiate our findings by directly examining if interventions aiming to increase MIL can reduce anhedonia. Meaning-centred approaches like logotherapy and existential interventions have shown effectiveness in augmenting individuals' sense of meaning and diminishing depressive symptoms (Sun et al., 2021b; Vos et al., 2015). Investigating whether these interventions also effectively alleviate anhedonia symptoms represents a valuable direction for future research.

4.2. Sense of self

We found that a reduced psychological sense of self indirectly predicted anhedonia mediated by MIL, both cross-sectionally and longitudinally. A reduced sense of self has been widely described in depression (Jones and Martini, 2021; Kopala-Sibley and Zuroff, 2020; Sokol and Eisenheim, 2016; Sokol and Serper, 2017), but we know of only one study associating a weakened sense of self with anhedonia (Sokol and Serper, 2019). However, as the latter study did not control for depression, we show for the first time that a reduced sense of self predicts anhedonia above and beyond depression symptoms. These results extend our previous qualitative study on anhedonia in which depressed adolescents questioned knowing themselves and their own interests and likes (Watson et al., 2020). A weakened psychological sense of self marked by difficulty knowing one's likes and interests could lead to reduced exposure to rewarding experiences in everyday life, thus contributing to anhedonia.

As the effect of the sense of self on anhedonia was mediated by MIL, future studies examining if strengthening the psychological sense of self can increase MIL are warranted. It may be the case that, when an individual becomes more aware of who they are and establishes clear and consistent interests, values and goals, they may experience a greater commitment to achieving these goals, and thus greater MIL (Allan et al., 2015; Bronk, 2011; Flury and Ickes, 2007), which may reduce anhedonia. Combining existing treatments that encourage patients to identify
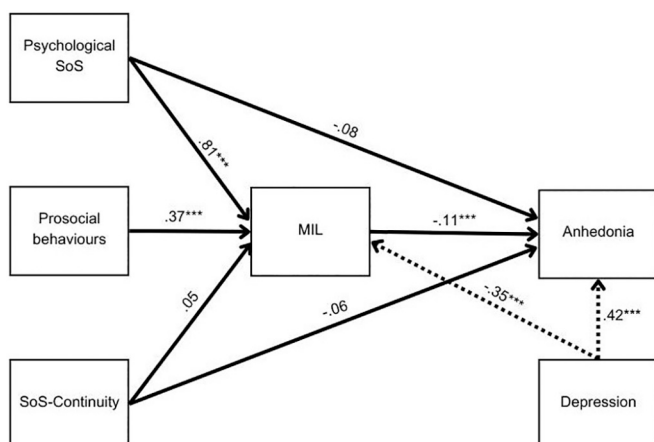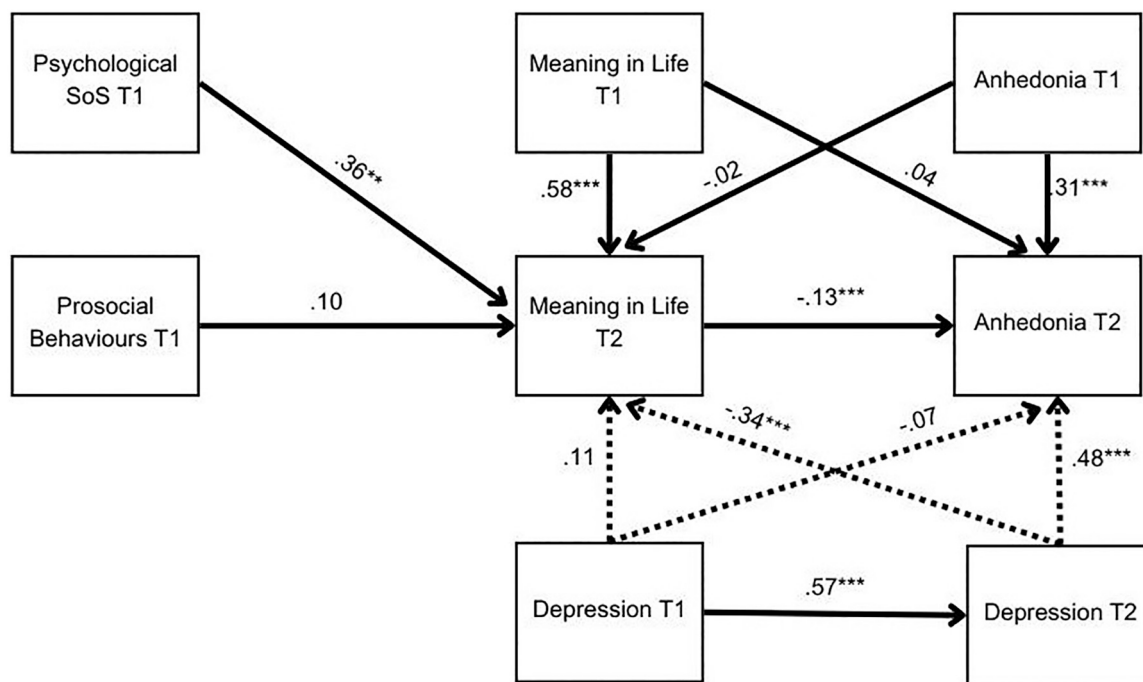
Fig. 4. The longitudinal path model after controlling for depression investigating the mediating influence of MIL on the effect of sense of self (psychological) and prosocial behaviours on anhedonia over time. Path coefficients between observed variabled are displayed as unstandardized regression coefficients. Covariates: age, gender, clinical diagnosis, and mood medication. **p<.01, ***p<.001.

values and goals (Lejuez et al., 2011) with interventions aimed at enhancing self-awareness could be a novel approach to treating patients with high anhedonia levels.

4.3. Prosocial behaviours

Another possible way to increase MIL is by encouraging prosocial behaviour i.e., voluntary behaviour that benefits others. Indeed, we found that increased prosocial behaviours predicted increased MIL, consistent with previous findings (Aknin et al., 2013; Alden and Trew, 2013; Klein, 2016; Midlarsky, 1991; Raposa et al., 2016; Schacter and Margolin, 2019; Snippe et al., 2017). Prosocial behaviours are thought to enhance positive affect by fostering social connections and a sense of meaning (Van Tongeren et al., 2015) without necessarily reducing negative affect (Inagaki and Orehek, 2017; Raposa et al., 2016; Schacter and Margolin, 2019; Telzer et al., 2014). This suggests that prosocial behaviours may be a suitable target for anhedonia treatments. Our findings support this notion, as we discovered that engaging in more prosocial behaviours indirectly predicted reduced anhedonia.

In this context, it is worth noting that adolescents may struggle to engage in prosocial behaviours. With underdeveloped frontal regions and impulsive tendencies (Steinberg, 2017), young people might often prefer immediate gratification over long-term benefits (Kim et al., 2014), especially if they are experiencing depression symptoms (Forbes and Dahl, 2005). However, encouraging prosocial activities in young people might help them to find greater meaning in life, which could shift their focus towards future rewards and reduce anhedonia (Kim et al., 2014). Thus, future studies would benefit from examining the effects of prosocial interventions on not just depression but also specifically on anhedonia symptoms.

4.4. Future directions

It should be noted that the current study relied on retrospectively completed questionnaire measures which may have introduced recall biases. Future studies could incorporate Ecological Momentary Assessment (EMA), which captures real-time experiences in natural environments, thereby minimizing recall bias and enhancing ecological validity (Shiffman et al., 2008). As a recently developed measure, the MSoS scale will benefit from additional testing and validation in diverse samples. In addition, future studies could replicate the current findings using other measures which capture similar self-related constructs as the MSoS scale, to further substantiate the current findings. As both anhedonia and meaning in life are multidimensional constructs (Martela and Steger, 2016; Rizvi et al., 2016) future studies could explore these dimensions and examine the relationships among the sub-constructs. Although we amended our hypothesised model using modification indices and there are supporting theoretical reasons for including the additional paths, it cannot be ruled out that the fit of the amended model was influenced by characteristics specific to our sample. It would, therefore, be prudent going forward to test the model fit in a separate sample. We conducted a longitudinal path analysis at two time points, future research should extend this analysis to three time points for a more detailed understanding of the mediated relationships. Furthermore, although questionnaire scores of the T1 and T2 samples were similar, it cannot be ruled out that participants who volunteered to take part in the T2 survey may have differed in some ways from those who did not (e.g. in terms of persistence or conscientiousness). In this study over 50 % of the sample had clinical levels of depression and anhedonia and we analysed the data with a dimensional approach, in line with recommendations from the NIMH Research Domains Criteria (RDoC; Insel et al., 2010). However, future studies could run categorical analyses and explore potential differences in model fit between those with a clinical diagnosis of depression and control groups.

4.5. Conclusion

In summary, we provide novel evidence that MIL, psychological sense of self and prosocial behaviours predict anhedonia in young people with depression symptoms, and that MIL mediates the effects of a psychological sense of self on anhedonia over time. These findings suggest that psychotherapeutic interventions targeting MIL,

psychological sense of self, or prosocial behaviours may be effective in alleviating anhedonia.

Ethics

The study conforms to the Declaration of Helsinki for medical research involving human subjects. Ethical approval was obtained from the University of Reading Psychology Department Ethics committee and all participants provided written informed consent.

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CRediT authorship contribution statement

Sena Demir-Kassem: Writing – review & editing, Writing – original draft, Formal analysis, Data curation, Conceptualization. **Anna-Lena Frey:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization. **Ciara McCabe:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization.

Declaration of competing interest

The authors report no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2024.09.106.

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