A dominance analysis on the relationship between schizotypy and loneliness type

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ABSTRACT

Background: This study investigated how individual differences in schizotypy differentially predicted types of loneliness – direct, social, emotional, and existential loneliness (in relationships and meaninglessness in life).
Methods: We presented participants with the brief version of the Oxford-Liverpool Inventory of Feelings and Experiences and the de Jong Giervald loneliness scale and used dominance analysis to evaluate the dominant predictors of schizotypy on loneliness. We also evaluated the impact of depression on each model.
Results: In our preregistered analysis we found evidence to suggest that cognitive disorganization and introvertive anhedonia are consistently the most dominant of the schizotypy predictors. Introvertive anhedonia was the most dominant predictor for social loneliness and existential loneliness in relationships, and cognitive disorganization was the most dominant predictor of direct, emotional and existential meaninglessness in life loneliness. Depression became the most dominant predictor of all types of loneliness when added to the models.
Limitations: This research is limited by the cross-sectional nature of the data which is unable to account for changes in loneliness over time, and we acknowledge that the relationship between predictors and outcome is likely bi-directional.
Conclusions: Our findings highlight the diverse relationship between schizotypy and loneliness type and suggest that schizotypy domains linked to social anxiety and withdrawal are key predictors of loneliness. These findings are important for the development of focused interventions and the prevention of clinical disorder development.

1. Introduction

1.1. Schizotypy and loneliness

Schizotypy refers to personality characteristics related to the positive, negative, and disorganized symptom clusters of schizophrenia, as well as commonly experienced social and behavioural issues and can be used to assess schizophrenia in sub-clinical populations (Esterberg and Compton, 2009; Mason et al., 2005; Meehl, 1962). Loneliness refers to the negative feelings caused by the subjective perception of insufficient relationships that fulfil the social need, which may or may not relate to the objective isolation of an individual (Chau et al., 2022b; Christensen et al., 2022; Hawkley and Kocherginsky, 2018; Van Tilburg, 2021). Understanding the individual differences between the schizotypal domains and their relationship with loneliness is important because social interactions or lack thereof, can contribute to the experience of

schizotypy, and possibly the development of schizophrenia. For example, persecutory delusions as a feature of positive schizotypy might lead an individual to withdraw socially. This can contribute to the aspects of negative and disorganized schizotypy that are relevant to social interactions, such as social anxiety or withdrawal (Christensen et al., 2022), which in turn have been shown to predict clinical psychosis (Eglit et al., 2018; Michalska Da Rocha et al., 2018; Trémeau et al., 2016). In this study we chose the Oxford-Liverpool Inventory of Feelings and Experiences (OLIFEb) over alternative measures because we were interested in the contribution of the four possible schizotypy domains to loneliness, including impulsive non-conformity (IN). This is because the IN subscale measures impulsive and anti-social behaviour which could affect loneliness through the response to an individual when exhibiting such behaviour.

Research on schizotypy and loneliness has demonstrated a generally positive relationship between positive, negative, and disorganized

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schizotypy with general loneliness (Chau et al., 2022a; Christensen et al., 2022), but the consistency of these results depends on how these analyses are structured (Chau et al., 2022a, 2022b; Christensen et al., 2022). For example, (Christensen et al., 2022) hypothesized a positive relationship between the positive and disorganized dimensions of schizotypy with loneliness. They also predicted a negative association between negative schizotypy and loneliness through low motivation or lack of reward in engaging with social interactions. Findings from separate multiple regressions confirmed that positive, negative, and disorganized schizotypy positively and significantly predicted loneliness, but when all three predictors were included in one multiple regression model, the relationship with positive schizotypy was reversed. Furthermore, when including a measure of depression in the model disorganized schizotypy was no longer a significant predictor (Christensen et al., 2022). The authors concluded that the largest effect sizes were demonstrated for negative and disorganized schizotypy and this likely reflects the importance of cognitive disorganization and social motivation on loneliness. They also suggested that the positive relationship between these variables is because even though social interactions are perceived as less rewarding, the need for them remains present, or because negative schizotypy strongly overlaps with depression (Achterbergh et al., 2020; Matthews et al., 2016).

Research conducted by Chau et al. (2022a), investigates related individual traits and the interactions between them with loneliness, via a network analysis. They found that all nine schizotypyal traits measured by the schizotypal personality questionnaire (SPQ; Raine and Raine, 1991) were connected to loneliness and 52 % of the variance in loneliness could be explained by five directly connected traits.

The notion that schizotypy traits might be differentially related to loneliness directly or indirectly might explain some of the contrasting results from research in the field (Chau et al., 2022a; Christensen et al., 2022; Le et al., 2019; Toh et al., 2022). For example, previous research has suggested that positive schizotypy may lead to increased loneliness through suspiciousness (Chau et al., 2022a; Narita et al., 2020; Sorenson et al., 2023), whilst the results on the relationship between negative schizotypy and loneliness are mixed (Christensen et al., 2022; Le et al., 2019). Disorganized schizotypy has also been suggested to contribute to increased loneliness through issues with communication, attention, social perception, and emotion recognition and what this might mean for navigating social situations (Chau et al., 2022a; Christensen et al., 2022; De Sousa et al., 2019; Le et al., 2019).

1.2. Different types of loneliness

While the measurement of general loneliness is well established, recent research has expanded the concept to distinct types of loneliness, such as social (lack of social connections), emotional (lack of close relationships), and existential loneliness (related to beliefs about the meaning of life), as well as direct loneliness where self-report items ask participants directly if they are lonely (Maes et al., 2022; Van Tilburg, 2021). Understanding the different types of loneliness is important because differential manifestation could affect the effectiveness of interventions aimed to reduce its affects. For example, someone who is physically isolated may respond to an increase of social interactions, while someone who is emotionally lonely due to the loss of a loved way may feel that way regardless of the social support and presence of others.

However, much of the existing research has focused on general loneliness and not different types of loneliness that may relate to schizotypy domains. For example, both disorganized and negative schizotypy include aspects that relate to social functioning and related feelings (Mason et al., 1995; Mason, 2015; Raine and Raine, 1991), as such it is reasonable to expect that high scores on these scales might be related to social and emotional loneliness, in particular. Similarly, the measurement of positive schizotypy includes items related to magical thinking, belief in the supernatural, or on the meaning of life and existence (Mason et al., 1995; Mason, 2015; Raine and Raine, 1991), as such

this dimension of schizotypy may be particularly related to existential loneliness, given some overlap in these themes (Easden et al., 2023; Mayers et al., 2002). Negative schizotypy could also contribute to this type of loneliness through the general avolition, apathy and low interest and motivation in life, that is supported by findings into existential loneliness and depression (Kretschmer and Storm, 2017).

1.3. The present study

The current study sought to investigate the contribution of specific domains of schizotypy as measured by the OLIFEb – unusual experiences (UE), cognitive disorganization (CD), introvertive anhedonia (IA), and impulsive non-conformity (IN) – on specific types of loneliness – direct, social, emotional, and existential, using dominance analysis. Dominance analysis concerns the evaluation of complete, conditional, or general dominance of a predictor over others in a regression model by determining the unique variance it contributes either across all possible submodels or on average across all possible subset sizes (Nimon and Oswald, 2013).We hypothesize that schizotypy will predict loneliness in general, but also that UE and IA will predict existential loneliness, that UE, IA and IN will predict emotional loneliness, and all four schizotypy sub-scales will predict social loneliness. We will also assess the dominance of each of the schizotypy domains as predictors of each type of loneliness. Our hypotheses were preregistered in advance of data collection on the Open Science Framework here: https://osf.io/m57gt/?view_only=17b05e47ed234443b864c07f88365eef.

2. Method

2.1. Participants

Six-hundred-and-three participants were recruited through the Prolific website ($N_{female} = 358$, $N_{male} = 234$, $N_{other} = 8$, $N_{prefernottosay} = 3$) aged between 20 and 81 ($M_{Age} = 42.2$, $SD_{Age} = 14.2$). Inclusion criteria restricted the age range of participants to be between 18 and 100 years of age and based in the UK. Sample size was determined using G*Power for a linear multiple regression (fixed model, r^2 deviation from zero) with one outcome and four predictors. We used a conservative small effect size of $f^2 = 0.02$ given limited similar analyses in the field on which to estimate an effect size and following best practice around the smallest effect size of interest and typical effect sizes found in the psychological literature (Funder and Ozer, 2019; Gignac and Szodorai, 2016; Lakens et al., 2018), along with an alpha level = 0.05 and power = 0.80 which returned a required sample size of 602 participants (the additional participant was recruited due to one of the original 602 participants failing two of the four attention checks). Participants received £2 for participating, were required to be over 18 years old and gave informed consent. The study was approved by the University of Winchester ethics committee (Faculty of humanities and social sciences; ethics no. HSSE16160).

2.2. Measures

2.2.1. Schizotypy

The brief version of the Oxford-Liverpool Inventory of Feelings and Experiences (OLIFEb; Mason et al., 2005) was used to measure the schizotypal traits across 43 items to measure unusual experiences (UE; 12 items), cognitive disorganization (CD; 11 items), introvertive anhedonia (IA; 10 items) and impulsive non-conformity (IN; 10 items). UE measures perceptual anomalies, magical thinking and experiences related to hallucinations, and relates phenomenologically to the positive symptoms of psychosis. CD refers to issues with attention, concentration, and anxiety in social situations, while IA measures a lack of pleasure or the avoidance of, physical and social intimacy, and is taken to reflect the negative symptoms of schizophrenia. Finally, the IN-subscale measures impulsive and anti-social behaviour, as well as issues with self-control

([Mason et al., 1995](); [Mason et al., 2005]()). Participants respond "Yes" (1) or "No" (0) to items and a higher score reflects higher levels of schizotypy. Internal consistency measured by Cronbach's α was 0.66 (IN), 0.67 (IA), 0.77 (UE) and 0.84 (CD).

2.2.2. Loneliness

Loneliness was measured according to the method used by [Van Tilburg (2021)](). This approach uses 5 direct loneliness questions from the De Jong Gierveld Scale (DJG; [de Jong-Gierveld and Kamphuls, 1985]()), the Center for Epidemiologic Studies Depression Scale ([Radloff, 1977]()) and the Existential Loneliness Questionnaire ([Mayers et al., 2002]()), and ask about direct loneliness in different ways, allowing for a more valid measure of direct loneliness. The response options vary across the 5 items: 0 to 3 for the items asking participants if they would classify themselves as lonely (where 0 = "Not lonely" 1 = "Moderately Lonely", 2 = "Strongly Lonely", 3 = "Very Strongly Lonely"), and "During the past week I felt lonely" (where 0 = "Rarely or never", 1 = "Some of the time", 2 = "Occasionally", 3 = "Mostly or Always"). Response options for "I sometimes feel lonely" was 0 to 2 (where 0 = "No", 1 = "More or less", 2 = "Yes"); and 0 to 4 for the items "I feel lonely" and "I feel alone" (where 0 = "No!", 1 = "no", 2 = "More or less", 3 = "yes" and 4 = "Yes!" for both items). Social Loneliness was measured using 5 items and Emotional Loneliness was measured across 6 items, from the DJG scale, where participants respond across a three-point scale of "no" (1), "more or less" (2), or "Yes" (3), meaning a possible range of 0 to 16 for direct loneliness, 5 to 15 for social loneliness, and 6 to 18 for emotional loneliness. Existential loneliness is measured across 14 items taken from the ELQ and across two further sub-types, existential loneliness in relationships (7 items) and existential loneliness: meaninglessness in life (7 items). Items for existential loneliness are scored across a 5-point scale of "No!" (1), "no" (2), "More or less" (3), "yes" (4) and "Yes!" (5), as in ([Van Tilburg, 2021]()) and higher scores reflect higher levels of existential loneliness. Internal consistency for the different types of loneliness scales were Cronbach's α = 0.82 (existential loneliness – relationships), α = 0.87 (emotional loneliness), α = 0.88 (social loneliness), α = 0.93 (direct loneliness) and α = 0.90 (existential loneliness – meaninglessness of life).), α = 0.88 (social loneliness), α = 0.93 (direct loneliness) and α = 0.90 (existential loneliness – meaninglessness of life).

2.2.3. Depression

The 21-item version of the Depression, Anxiety and Stress Scales (DASS21, [Lovibond and Lovibond, 1995]()) was used to measure depression, anxiety, and stress, although only depression was included in the analysis (7 items). Participants are asked to respond across a 4-point scale of "Did not apply to me at all" (0), "Applied to me to some degree, or some of the time" (1), "Applied to me a considerable degree or a good part of time" (2), and "Applied to me very much or most of the time" (3). Higher scores represent higher degrees of depression. Cronbach's α value for depression scores on the DASS was 0.94.

2.3. Procedure

The study was administered using Qualtrics via Prolific and participants were first asked to give informed consent and demographic information (age and gender identification). Then they completed the measures in three blocks, one for loneliness, one for the OLIFEb, and one for the DASS, the presentation order of the blocks was evenly counterbalanced across participants so that not all participants completed the measures in the same order.

2.4. Statistical analysis and data validation

2.4.1. Data cleaning

In line with our preregistered data validation procedures, we cleaned data based on responses to four attention checks across the measures (where participants were asked to select a specific response to a question – e.g. "please select 'YES' for this question"), invariant responding and outlier responses. This identified $n = 1$ who missed two attention checks and were subsequently cleaned from the data. A further $N = 1$ participant was cleaned due to invariant ($SD_{ParticipantResponse} = 0$) responses to the OLIFEb. After data validation and cleaning, there were $N = 601$ participants ($M_{Age} = 42.2$, $SD_{Age} = 14.2$, $N_{female} = 357$, $N_{male} = 233$, $N_{other} = 8$, $N_{prefernottosay} = 3$).

2.4.2. Analysis plan

Our hypotheses investigate how the OLIFEb subscales predict different types of loneliness. To test these, we use multiple linear regressions with the four OLIFEb subscales as predictors on direct, social, emotional, and existential (two types) loneliness as outcome variables, with and without depression to evaluate the change in models when this additional predictor is added. In addition, we use dominance analysis to explore the dominant contribution of the predictors on the outcome variable for each regression model and we also include depression, anxiety and stress scores in a correlation with schizotypy and loneliness to explore the associations amongst these. We chose not to include DASS-anxiety and stress as predictors in the regression models because they likely measure the same underlying latent variable as DASS-depression, potentially introducing issues with multi-collinearity, model-fit and statistical power for the resources available. All regression and dominance models are built using the R package, 'yhat' using the all-possible-subsets function. We report the results of each regression and the dominance weights for each predictor and draw inference from p values ($p < .05$) and estimates of effect size. At the request of peer reviewers, we have included Bayes Factors as a means to compare each regression to the null model and adjusted our p values for overall models and beta coefficients to account for multiple testing across the five different types of loneliness to a more conservative $p < .001$.

3. Results

All data for analyses can be found on the OSF here: [https://osf.io/m57gt/?view_only=17b05e47ed234443b864c07f88365eef]().

For all regression models, multicollinearity statistics indicated no issues with predictors being too correlated (all Tolerance >0.2 and all VIF < 10). Descriptive statistics and Pearsons r correlations for the psychometric measures are shown in [Tables 1 and 2](). The means and standard deviations for the UE and IN subscales were similar to the descriptive statistics given in [Mason et al., 2005](), while the mean scores for CD and IA were greater in this study.

3.1. Direct loneliness

A multiple regression with dominance analysis conducted on the four OLIFEb subscales as predictors and direct loneliness score as the outcome was significant, $F(4,592) = 61.11$; $p < .001$; Adj $r^2 = 0.29$, $BF_{10} = 4.583*10^{+40}$, with the standardized beta coefficients for CD ($\beta = 0.39$), IA ($\beta = 0.17$) and IN ($\beta = 0.12$) positively and significantly predicting direct loneliness. CD was identified as the most dominant predictor. See [Table 3]() for a comparison of model statistics including general dominance weights and rankings.

3.2. Social and emotional loneliness

A multiple regression with dominance analysis with the same OLIFEb subscales as predictors as the previous section, and social loneliness as the outcome variable was significant, $F(4,592) = 52.63$; $p < .001$; Adj $r^2 = 0.26$, $BF_{10} = 4.515*10^{+34}$, with the standardized beta coefficients for CD ($\beta = 0.10$), IA ($\beta = 0.43$) and IN ($\beta = 0.01$) positively and significantly predicting social loneliness, with IA identified as the most dominant predictor. See [Table 4]() for a comparison of model statistics including general dominance weights and rankings.

Table 1
Descriptive statistics for psychometric measures.

Measure	Mean (sd.)	Std Deviation	Minimum	Maximum
OLIFEb				
Unusual Experiences	3.1	2.6	0	11
Cognitive Disorganization	5.4	3.3	0	11
Introvertive Anhedonia	3.6	2.4	0	10
Impulsive Non-conformity	2.8	2.1	0	9
Loneliness				
Direct Loneliness	5.5	4.4	0	16
Social Loneliness	9.5	3.2	5	15
Emotional Loneliness	10.4	3.9	6	18
Existential Loneliness (Relationships)	16.3	5.2	7	32
Existential Loneliness (Meaninglessness of life)	16.4	6	7	34
DASS				
Depression	5.9	5.6	0	21
Anxiety	3.5	3.6	0	15
Stress	6.2	4.5	0	20

Note: For the OLIFEb subscales the range of possible scores are 0–12 (UE), 0–11 (CD), 0–10 (IA), 0–10 (IN). For the loneliness scales possible score ranges are 0–16 (direct loneliness), 5–15 (social loneliness and emotional loneliness), 7–35 (existential loneliness-relationships and meaninglessness). Possible scores for all three DASS scales (depression, anxiety and stress) range from 0 to 21.

The model for emotional loneliness, with the OLIFEb subscales as predictors was also significant, $F(4,592) = 54.99$; $p < .001$; Adj $r^2 = 0.27$, $BF_{10} = 1.364*10^{+36}$ with the standardized beta coefficients for CD ($\beta = 0.45$) and IA ($\beta = 0.13$) positively and significantly predicting emotional loneliness, with CD identified as the most dominant predictor, followed by IA, UE and then IN. See Table 4.

3.3. Existential loneliness – Relationships and meaninglessness in life

A multiple regression with dominance analysis on existential loneliness-relationships with the four OLIFEb subscales as predictors was significant, $F(4,591) = 92.57$; $p < .001$; Adj $r^2 = 0.38$, $BF_{10} = 4.583*10^{+57}$, with the standardized beta coefficients for CD ($\beta = 0.34$) and IA ($\beta = 0.33$) positively and significantly predicting existential relationship loneliness, with CD identified as the most dominant predictor.

For existential loneliness-meaninglessness in life, the model was also significant, $F(4,590) = 88.94$; $p < .001$; Adj $r^2 = 0.37$, $BF_{10} =$

Table 3
Dominance analysis statistics for the four OLIFEb subscales as predictors of direct loneliness.

Measure	b	Beta	Confidence intervals		Dominance statistics	
			Lower	Upper	General	Rank
Intercept	1.11***		0.46	1.76		
Unusual experiences	−0.07	−0.04	−0.21	0.07	0.02	4
Cognitive disorganization	0.52***	0.39	0.39	0.64	0.16	1
Introvertive anhedonia	0.31***	0.17	0.17	0.45	0.06	2
Impulsive non-conformity	0.26**	0.12	0.07	0.44	0.29	3

Note: Significance values denoted as $p < .01**$, $p < .001***$.

Table 4
Dominance analysis statistics the four OLIFEb subscales as predictors of social and emotional loneliness.

Measure	b	Beta	Confidence intervals		Dominance statistics	
			Lower	Upper	General	Rank
Social loneliness						
Intercept	6.58***		6.10	7.07		
Unusual experiences	−0.05	−0.04	−0.16	0.06	0.01	4
Cognitive disorganization	0.10	0.10	0.01	0.19	0.05	2
Introvertive anhedonia	0.59***	0.43	0.49	0.69	0.19	1
Impulsive non-conformity	0.15	0.10	0.01	0.29	0.02	3
Emotional loneliness						
Intercept	6.78***		6.20	7.37		
Unusual experiences	0.05	0.03	−0.08	0.17	0.03	4
Cognitive disorganization	0.52***	0.45	0.41	0.62	0.17	1
Introvertive anhedonia	0.22***	0.13	0.10	0.35	0.05	2
Impulsive non-conformity	−0.04	−0.02	−0.21	0.13	0.03	3

Note: Significance values denoted as $p < .01**$, $p < .001***$.

Table 2
Pearson r correlations for psychometric measures.

Measure	UE	CD	IA	IN	DL	SL	EL	ExL (R)	ExL (M)	D	A
OLIFEb											
UE											
CD	0.50										
IA	0.19	0.42									
IN	0.55	0.58	0.25								
Loneliness											
DL	0.25	0.51	0.35	0.36							
SL	0.15	0.32	0.50	0.24	0.57						
EL	0.27	0.51	0.32	0.29	0.75	0.60					
ExL (R)	0.32	0.54	0.50	0.37	0.69	0.70	0.68				
ExL(M)	0.21	0.54	0.46	0.38	0.70	0.55	0.59	0.71			
DASS											
Depression	0.35	0.63	0.43	0.50	0.67	0.48	0.57	0.65	0.79		
Anxiety	0.47	0.57	0.28	0.46	0.47	0.26	0.44	0.46	0.52	0.67	
Stress	0.46	0.66	0.31	0.52	0.50	0.32	0.47	0.53	0.54	0.72	0.72

Table 5

Dominance analysis statistics for the four OLIFEb subscales as predictors of existential loneliness – relationships, and meaninglessness in life.

Measure	b	Beta	Confidence intervals		Dominance statistics	
			Lower	Upper	General	Rank
Existential loneliness: Relationships						
Intercept	10.11***		9.40	10.83		
Unusual experiences	0.11	0.06	−0.04	0.27	0.04	4
Cognitive disorganization	0.52***	0.34	0.38	0.65	0.15	1
Introvertive anhedonia	0.71***	0.33	0.56	0.87	0.15	2
Impulsive non-conformity	0.17	0.07	−0.04	0.38	0.05	3
Existential loneliness: Meaninglessness in life						
Intercept	9.70***		8.86	10.53		
Unusual experiences	−0.31***	−0.14	−0.50	−0.13	0.02	4
Cognitive disorganization	0.71***	0.40	0.56	0.87	0.17	1
Introvertive anhedonia	0.71***	0.28	0.53	0.89	0.12	2
Impulsive non-conformity	0.48***	0.17	0.24	0.72	0.06	3

Note: Significance values denoted as $p < .01$**, $p < .001$***.

$4.959 * 10^{+55}$, with the standardized beta coefficients for UE ($\beta = -0.14$), CD ($\beta = 0.40$), IA ($\beta = 0.28$) and IN ($\beta = 0.17$) significantly predicting existential loneliness – meaninglessness in life, with CD identified as the most dominant predictor. See Table 5 for a comparison of model statistics including general dominance weights and rankings for both existential loneliness domains.

3.4. Adding depression to the regression models

The addition of DASS-depression scores as predictors alongside the four OLIFEb subscales to each of the regression models on direct, $F(5,591) = 106.3$; $p < .001$; Adj $r^2 = 0.47$, $BF_{10} = 2.648 * 10^{+76}$ social $F(5,591) = 57.91$; $p < .001$; Adj $r^2 = 0.32$, $BF_{10} = 4.616 * 10^{+45}$, emotional, $F(5,591) = 71.43$; $p < .001$; Adj $r^2 = 0.37$, $BF_{10} = 1.037 * 10^{+55}$ and both types of existential loneliness (in relationships: $F(5,590) = 113.4$; $p < .001$; Adj $r^2 = 0.49$, $BF_{10} = 2.087 * 10^{+80}$ and meaninglessness in life: $F(5,589) = 235.3$; $p < .001$; Adj $r^2 = 0.66$, $BF_{10} = 1.145 * 10^{+134}$) significantly improved the model fit for each one, and depression became the most dominant predictor for all models except social loneliness (see Table 6 for beta values and dominance ranks). In addition, for Direct loneliness only CD remained a significant predictor when depression was added to the model. For Social loneliness, depression became the second most dominant predictor behind IA. For existential loneliness in relationships, adding depression reduced the effect of CD such that IA became the second most dominant predictor (but CD remained significant), and for existential loneliness meaninglessness in life, IN was no longer significant following the addition of depression. See Table 6 for all models with depression included.

4. Discussion

The current study investigated the relationship between schizotypy and different types of loneliness. Overall, we found evidence that schizotypy predicts direct, social, emotional, and existential loneliness with different schizotypal domains being dominant for different types of loneliness. We also confirm findings of previous research regarding the dominance of depression over schizotypy domains in predicting all but social loneliness.

4.1. Depression

Adding depression to all models significantly improved the model fit and depression becomes the most dominant predictor for all models except social loneliness, supporting previous research (Christensen et al., 2022). For direct and emotional loneliness, the addition of depression to the models meant introvertive anhedonia became non-significant. This suggests that depression is a better predictor of the

negative affect that accompany loneliness than IA. However, IA was a better predictor of social loneliness than depression, indicating that the tendency to avoid social situations and the lack of pleasure obtained has a more practical impact on loneliness through diminished social contacts and relationships.

When adding depression to the model, the relationship between IN and direct, and existential loneliness-meaninglessness in life, decreased and became non-significant. This suggests that depression accounts for more variance in the data related to direct feelings around loneliness and life, than anti-social feelings. However, for emotional loneliness, the negative beta coefficient for IN became stronger, though this did not reach the threshold for our more conservative p value for multiple testing.

The only time adding depression to a model changed the order of dominance for the predictors was for existential loneliness in relationships, where IA became more dominant than CD. This result was driven by a larger decrease in the variance accounted for by CD when depression was added to the model than for IA. This could suggest an interaction effect between depression and CD, whereby high levels of depression subsume some of the variance accounted for by the social anxiety element of CD.

4.2. Cognitive disorganization and Introvertive anhedonia

For all types of loneliness, CD and IA were the two most dominant of the schizotypy predictors, confirming findings from previous research (Chau et al., 2022a; Christensen et al., 2022). Both domains have social elements – social anxiety for CD and lack of motivation and/or enjoyment taken from social situations for IA (Mason et al., 1995; Mason et al., 2005). CD was the most dominant predictor of direct, emotional, and existential meaninglessness in life loneliness (behind depression), suggesting that social anxiety is an important contributing factor of negative affect and feelings around loneliness and life. IA was the most dominant predictor of social and existential loneliness in relationships (behind depression) followed by CD. Conceptually, existential loneliness in relationships reflects beliefs about the meaning and nature of life and relationships, and IA as a positive predictor of this type of loneliness suggests that a lack of motivation to engage with social sources of pleasure is accompanied by negative beliefs about the existential nature of relationships.

4.3. Unusual experiences and impulsive non-conformity

UE were only a significant predictor of existential loneliness meaninglessness in life, but in the opposite direction to our hypothesis, meaning that high scorers scored lower on this type of loneliness. This is surprising, given the overlap in these measures and contradicts previous

Table 6

Dominance analysis statistic for all Models after DASS Depression was added as a predictor alongside the four OLIFEb subscales.

Measure	b	Beta	Confidence intervals		Dominance statistics	
			Lower	Upper	General	Rank
Direct loneliness						
Intercept	1.59		1.03	2.16		
Unusual experiences	−0.04	−0.03	−0.17	0.08	0.02	5
Cognitive disorganization	0.18**	0.14	0.07	0.29	0.10	2
Introvertive anhedonia	0.1	0.06	−0.02	0.23	0.04	3
Impulsive non-conformity	0.01	0.01	−0.14	0.18	0.04	4
DASS-depression	0.46***	0.57	0.39	0.52	0.28	1
Social loneliness						
Intercept	6.79***		6.33	7.26		
Unusual experiences	−0.04	−0.03	−0.14	0.06	0.01	5
Cognitive disorganization	−0.05	−0.05	−0.14	0.04	0.03	3
Introvertive anhedonia	0.50***	0.37	0.40	0.60	0.15	1
Impulsive non-conformity	0.04	0.03	−0.10	0.18	0.02	4
DASS-depression	0.20***	0.35	0.15	0.25	0.12	2
Emotional loneliness						
Intercept	7.11***		6.56	7.65		
Unusual experiences	0.07	0.04	−0.05	0.18	0.02	5
Cognitive disorganization	0.29***	0.25	0.18	0.40	0.11	2
Introvertive anhedonia	0.08	0.05	−0.04	0.20	0.03	3
Impulsive non-conformity	−0.21	−0.11	−0.37	−0.05	0.02	4
DASS-depression	0.31***	0.44	0.25	0.37	0.19	1
Existential loneliness - Relationships						
Intercept	10.53***		9.88	11.19		
Unusual experiences	0.14	0.07	−0.01	0.28	0.03	5
Cognitive disorganization	0.22**	0.14	0.09	0.35	0.10	3
Introvertive anhedonia	0.53***	0.24	0.39	0.67	0.11	2
Impulsive non-conformity	−0.05	−0.02	−0.24	0.14	0.04	4
DASS-depression	0.41***	0.44	0.33	0.48	0.21	1
Existential loneliness – Meaninglessness in life						
Intercept	10.48***		9.87	11.10		
Unusual experiences	−0.27***	−0.12	−0.41	−0.14	0.02	5
Cognitive disorganization	0.13	0.08	0.01	0.25	0.10	2
Introvertive anhedonia	0.36***	0.14	0.23	0.49	0.08	3
Impulsive non-conformity	0.07	0.02	−0.11	0.25	0.04	4
DASS-depression	0.78***	0.72	0.72	0.85	0.42	1

Note: Significance values denoted as $p < .01**$, $p < .001***$.

research linking positive schizotypy with negative affect (Kwapil et al., 2012). However, in contrast this finding supports research into the relationship between positive schizotypy and a positive outlook, including the search for meaning (Crespi et al., 2019).

Adding depression to the model increased the negative effect of IN on emotional loneliness. This could mean an interaction effect where high scorers on depression are less likely to be emotionally lonely if they also score highly on IN, perhaps because they are less likely to feel negatively about lacking close emotional attachment to others. This increase did not meet the more conservative threshold of $p < .01$ for multiple testing however, and so further research is needed.

4.4. Implications

Findings from this study demonstrate that CD, in part measuring social anxiety, and IA, measuring social avoidance, are differentially dominant predictors of direct, social, emotional, and existential loneliness. Social anxiety and social withdrawal have been shown to be key factors in predicting clinical psychosis (Eglit et al., 2018; Michalska Da Rocha et al., 2018; Trémeau et al., 2016) and areas of focus of interventions to improve loneliness (Caple et al., 2023; Mann et al., 2017; Williams et al., 2021). However, findings from the present study suggest that type of loneliness should be considered when tailoring interventions to individuals, with a combined approach to addressing social anxiety and social withdrawal being key points of focus. This could be achieved via the encouragement of small, positive, and frequent social interactions as demonstrated through research showing this approach reduces feelings of loneliness and negative affect, including depression (Kuczynski et al., 2022; Macdonald et al., 2021; Song et al., 2018). Further research is also needed into how these psychometric measures might interact with other known factors that affect loneliness, such as demographic factors.

4.5. Limitations and future research

The main limitation is the cross-sectional nature of the data which is typical of this kind of research. We have investigated how schizotypy predicts different types of loneliness and framed this relationship around how interventions may prevent the development of clinical psychosis, however, the nature of the relationship is likely bi-directional with both constructs contributing to the maintenance of the other. Similarly, the data's cross-sectional nature captures loneliness at one timepoint when some research suggests that loneliness fluctuates over a day (Kuczynski et al., 2022). In this study we focused on the dominance of predictors using dominance analysis but there are several other analytical methods that could be useful in exploring bi-directionality, such as network analysis. Another limitation involves the use of the short version of the OLIFEb given issues with consistency of the psychometric properties

found in comparison to the full version (Fonseca-Pedrero et al., 2015), although the obvious advantage of this approach is the reduced number of items and decreased likelihood of response fatigue. A further limitation was the choice not to collect data on diagnoses of depression or other psychotic disorders in the sample, which is a potential issue as formal diagnoses could contribute to an individual's experience and feelings of loneliness. This may not be an issue within the context of exploring how depression and the schizotypy domains explain variance in the models used here, but it is problematic for the extent to which we can generalize these findings to non-clinical populations. Similarly, we did not analyse data on known factors that affect loneliness such as age and gender or collect data on individual and family demographics. This is because our focus was on the relationship between schizotypy, depression and loneliness and including additional predictors would likely cloud the nature of that relationship given the varied findings in the literature (Barreto et al., 2021; Maes et al., 2019; Wickens et al., 2021), though any comprehensive model of loneliness aimed to inform intervention should include such factors. Finally, the current study considered all four schizotypy domains as predictors on an equal basis, without considering any hierarchies or interactions, though the findings may help in identifying which to focus on. Future research should focus on the interplay between depression and the schizotypy domains and how they affect loneliness.

4.6. Conclusion

The current study showed that the most dominant schizotypy predictors of loneliness differed depending on loneliness type and whether depression was included in the model, but overall depression, cognitive disorganization, and introvertive anhedonia, were consistently dominant in predicting loneliness.

CRediT authorship contribution statement

Jordan Randell: Writing – review & editing, Writing – original draft, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Debra Gray:** Writing – review & editing, Conceptualization. **Michelle Cleveland:** Writing – review & editing. **Rachel Manning:** Writing – review & editing.

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Declaration of competing interest

No potential conflict of interest was reported by the author(s).

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Data availability

The data used in this study are stored on the Open Science Forum.

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