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Abstract:

Background: Camouflaging is frequently reported in autistic people and entails the disguising of autistic traits in social situations. Camouflaging is associated with poor mental health in autistic people. This study examined the manifestation of camouflaging in a non-autistic sample, examining the relationship between autistic traits, self-reported camouflaging, gender, and mental health.

Method: 110 non-autistic adults completed standardised self-report questionnaires which measured: autistic traits, mental health symptoms, and camouflaging behaviours. Hierarchical multiple linear regression models were used to analyse data and examine the unique contributions of autistic traits and camouflaging to mental health.

Results: Self-reported autistic traits were associated with increased symptoms of poor mental health. However, autistic traits were not associated with mental health symptoms when controlling for self-reported camouflaging, and self-reported camouflaging predicted increased mental health symptoms over and above the effects of autistic traits. Women had poorer mental health than men in our sample, and in women there was a stronger relationship between camouflaging and mental health compared to men.

Conclusions: Camouflaging may contribute to poor mental health outcomes in the general population, just as it does for autistic people, to the extent that camouflaging more clearly relates to mental health profile than self-reported autism traits. This suggests camouflaging is an important construct for understanding mental health in general, and for exploring the complex relationship between autism and autistic traits.

Main text

Research has often framed autistic people as lacking social motivation, exhibiting deficits in empathy, and possessing an impaired theory of mind.[1–3] However, there is growing evidence that these abilities are not universally reduced in autistic people and that the evidence base is constrained by reliance on normative measures.[4–7] Many autistic people consider social relationships highly rewarding and work hard to engage socially with the neurotypical majority.[8–10]

One process which demonstrates the social motivations of autistic people is camouflaging.[11,12] Camouflaging refers to a range of strategies used by autistic people to minimise the visibility of traits or behaviours characteristic of autism and compensate for social and communication differences.[11] Camouflaging involves suppressing behaviours associated with autism, minimizing responses to sensory overstimulation, adopting a 'mask' or persona during social interactions, and developing explicit compensatory strategies to meet social and communication demands.[11,13] Understanding the manifestation and cognitive underpinnings of camouflaging has important implications for the identification and clinical diagnosis of autism, as skilled camouflagers may appear behaviourally neurotypical, preventing access to appropriate support and services.[14] There is substantial investigation into whether high rates of camouflaging may partially explain under-diagnosis of autism in people assigned female at birth.

The most frequently reported reasons for camouflaging are to 'pass' as neurotypical and blend in with wider society, more easily make friends, and to avoid bullying and being ostracized.[11,15,16] However, despite its intended protective effect, research has demonstrated that camouflaging has significant negative consequences for mental health.[13,16,17] Many individuals also report that camouflaging has a significant negative effect on their self-image and can cause them to feel uncertain about their authentic identity.[11,18,19]

Camouflaging is not a process unique to autistic people and may best be understood as a response to the stigma that autistic people experience.[20] Many people with a stigmatised identity may attempt to conceal this identity when interacting with others through means of information control and self-presentation management, reminiscent of the camouflaging strategies described by autistic people.[21] Research on transgender and minority sexual identity groups suggests that while concealment of a stigmatised identity is frequently associated with distress and poorer mental health, non-concealment is associated with increased exposure to discrimination, victimisation, and ostracization, which in turn impacts mental health.[22–25] This corresponds directly with findings from autism research [26] and has implications for understanding autistic camouflaging as many autistic people belong to multiple stigmatised groups, and so may be camouflaging multiple aspects of their identity.[20]

Sub-clinical autistic traits (defined as autistic traits that do not meet the clinical threshold for diagnosis) as measured by standardized self-report measures are consistently associated with poorer mental health in the general population [27–29]and in clinical populations with mood, anxiety, and eating disorders.[30–33] Self-reported autistic traits have also been found to significantly predict suicidality in non-autistic people.[17,34] Factors that mediate these associations include past bullying experiences, social problem-solving ability, a negative problem-solving orientation, repetitive cognition, peer social-connectedness, and loneliness.[28,35–38] Notably, many of these mediators relate to the interaction of autistic traits with the social experiences of individuals. Autistic adults camouflage due to social difficulties and stigma associated with their autistic traits; therefore, non-autistic people with elevated levels of sub-clinical autistic traits may also be motivated to camouflage in social interactions for similar reasons.[13] Supporting this, one study compared the social compensatory strategies of autistic adults and non-autistic adults who self-reported using strategies to 'fit in' and found that the two groups used qualitatively similar strategies.[15] Camouflaging may then represent an important factor in the relationship between autistic traits and mental health in non-autistic people.

The current study aims to explore the potential detrimental consequences of camouflaging in a non-autistic sample. By studying camouflaging in a non-autistic sample we can further develop our understanding by identifying whether the established relationship between camouflaging and mental health in autistic people also exists in the general population. While the findings of studies on autistic traits in non-autistic samples cannot be understood as extending to autistic people[39] knowing whether camouflaging has negative effects for non-autistic people, which track with the degree of self-report autistic traits, can help inform debates about the extent to which autistic mental health difficulties are dictated by social forces such as stigma (and the camouflaging it engenders). Moreover, our findings can be used to generate hypotheses for future studies exploring the continuity of experience between autistic and non-autistic people. We also seek to better understand the relationship between autistic traits and mental health in non-autistic people and the influence of camouflaging in this relationship. The primary research question is: What are the unique contributions of autistic traits and camouflaging to mental health in non-autistic adults?

Methods

Participants

Participants were 110 non-autistic adults aged 18 – 89 years (mean age = 41.71; SD = 15.92). Thirty-two participants reported their gender identity as "Man/Male", 72 participants reported their gender identity as "Woman/Female", and 6 participants did not disclose their gender identity. Gender identity was reported through an open-response format. Inclusion criteria for the study were normal or corrected vision; being over the age of 18; and the absence of any self-reported neurological disorder which may have impacted performance on executive function tests. All 110 participants completed all of the questionnaires fully and there were no missing data on the questionnaires

Materials & Design

Participants completed the Camouflaging Autistic Traits Questionnaire (CAT-Q), the Depression, Anxiety, Stress Scales (DASS) and the Autism-Spectrum Quotient (AQ). The CAT-Q is a 25-item self-report measure quantifying social camouflaging behaviours.[13] The DASS is a 42-item self-report instrument designed to measure the frequency and severity of depression, anxiety, and stress symptoms.[40] The AQ is a 50-item self-report measure of autistic traits intended for adults with average IQ or above and designed to assess 5 domains: social skills, communication, attention switching, attention to detail, and imagination.[41] For more details on the psychometric properties of the measures please see the supplementary materials.

Procedure

The study was approved by the University of Edinburgh Ethics Committee. We recruited participants through multiple channels, including the School of Philosophy, Psychology and Language Sciences volunteer panel and social media. All participants completed the self-report measures online.

Analysis

We conducted all analyses in R version 3.5.1.[42] We conducted a series of hierarchical multiple linear regression analyses to examine the relationships between mental health and camouflaging. DASS total score was the outcome variable, and AQ score, CAT-Q score, Gender, the interaction between CAT-Q score and Gender, and Age were the predictors. No other variables were adjusted for in the reported models. We dropped six cases from the model in the step when Gender was added as a predictor and an additional two cases were dropped from the model when Age was added as a predictor as those participants did not report their gender or age respectively. For each of the regression models, we conducted non-constant variance tests to detect whether the models met the assumption of homogeneity of variance. These tests revealed significant violations ($p < 0.05$) to the assumption of homogeneity of variance. This means that the standard error estimates and t-tests for the regression coefficients are not entirely reliable.[43] To accommodate this violation, we calculated the standard errors and t-tests for the coefficients using heteroscedasticity corrected covariance matrices following recommended practice.[43] Scrutinizing of model diagnostic plots revealed no further violations.

Results

Scores on the AQ were significantly positively correlated with scores on the CAT-Q (r (108) = 0.72, p < 0.001, 95% CI = 0.615, 0.799) suggesting that increased autistic traits are associated with increased

levels of camouflaging. Descriptive statistics and t-tests for gender differences are reported in the supplementary materials.

To explore the relationship between autistic traits, camouflaging, and mental health, we conducted a hierarchical multiple linear regression analysis (see Table 1). In step one of the model, DASS score was the outcome variable, and AQ was the predictor variable. The regression equation was significant $(F_{(1, 108)} = 19.34, p < 0.001)$, with an adjusted R^2 of 0.144. AQ significantly predicted DASS score ($t = 3.24, p = 0.002$).

In step two of the model, we added CAT-Q scores as an additional predictor variable, leading to a statistically significant increase in adjusted R^2 of 0.15 $(F_{(1, 107)} = 25.16, p < 0.001)$. The regression equation for step two of the model was significant $(F_{(2, 107)} = 23.24, p < 0.001)$ with an adjusted R^2 of 0.29. CAT-Q score significantly predicted DASS score ($t = 5.29, p < 0.001$), while AQ score was no longer a significant predictor ($t = -0.11, p = 0.90$). For every single unit increase in CAT-Q score, DASS score increased by 0.456 units. The results of the hierarchical multiple regression model suggest that when the additional effects of camouflaging are controlled for, autistic traits do not predict mental health in the current sample. Increased camouflaging predicts poorer mental health over and above the effect of autistic traits, accounting for an additional 14.6% of variance. The variance inflation factor for the predictor variables in this model was 2.074. A VIF of 2.5 or greater is generally considered to be indicative of substantial collinearity.[44]

insert table 1.

In step three of the model, we added gender as an additional predictor variable, leading to a statistically significant increase in adjusted R^2 of 0.07 $(F_{(1, 100)} = 8.33, p = 0.005)$. The regression equation for step three of the model was significant $(F_{(3, 100)} = 20.03, p < 0.001)$ with an adjusted R^2 of 0.357. CAT-Q score ($t = 5.07, p < 0.001$) and Gender ($t = -2.83, p = 0.006$) significantly predicted DASS score, and AQ was not a significant predictor ($t = 0.41, p = 0.684$). The results of this model suggest increased camouflaging predicted increased symptoms of poor mental health and women had poorer mental health than men.

In step four of the model, we added the interaction effect between CAT-Q score and Gender as an additional predictor variable, leading to a statistically significant increase in adjusted R^2 of 0.021 $(F_{(1, 99)} = 4.05, p = 0.047)$. The regression equation for step four of the model was significant $(F_{(4, 99)} = 16.49, p < 0.001)$ with an adjusted R^2 of 0.378. CAT-Q score ($t = 5.35, p < 0.001$) significantly predicted DASS score but AQ ($t = 0.23, p = 0.823$), Gender ($t = 1.31, p = 0.195$) and the interaction of CAT-Q score and Gender ($t = -1.89, p = 0.061$) were not significant predictors.

In step five of the model, we added Age as an additional predictor variable. Compared to step 4 of the model, this did not lead to a significant increase in adjusted R^2 $(F_{(2, 96)} = 0.69, p = 0.407)$, meaning that the addition of Age as a predictor did not improve the model. The regression equation for step five of the model was significant $(F_{(5, 96)} = 12.93, p < 0.001)$ with an adjusted R2 of 0.371. CAT-Q score ($t = 5.03, p < 0.001$) significantly predicted DASS score but AQ ($t = 0.18, p = 0.860$), Gender ($t = 1.26, p = 0.209$), the interaction of CAT-Q score and Gender ($t = -1.79, p = 0.077$) and Age ($t = -0.88, p = 0.384$) were not significant predictors.

In step six of the model, we were interested to examine further the specific effect of the interaction between CAT-Q score and Gender in the absence of the main effect of Gender and Age. In this model the predictor variables were AQ, CAT-Q score, and the interaction between CAT-Q score and Gender, and DASS score was the outcome variable. Compared to step two of the model, this led to a statistically significant increase in adjusted R^2 of 0.083 (F $(1, 100)$ = 11.06, p = 0.001. The regression equation for step six of the model was significant (F $(3, 100)$ = 21.38, p < 0.001) with an adjusted R^2 of 0.373. CAT-Q score (t = 5.34, p < 0.001) and the interaction effect between CAT-Q score and Gender (t = -2.99, p = 0.004) significantly predicted DASS score, while AQ was not a significant predictor (t = 0.36, p = 0.721). This model suggests that camouflaging relates to poor mental health and a significant component of high DASS scores in this sample is driven by the additional camouflaging burden carried by women.

The results of the hierarchical multiple regression models suggest that when the additional effects of camouflaging are controlled for, autistic traits do not predict symptoms of poor mental health in the current sample. Increased camouflaging predicts poorer mental health over and above the effect of autistic traits, and this is particularly the case for women. Age does not predict symptoms of poor mental health in the current sample.

Insert figure 1.

Discussion

Consistent with previous research, a significant positive relationship was found between autistic traits and poor mental health. However, when taking account of self-reported camouflaging, the relationship between autistic traits and mental health was no longer significant and camouflaging instead emerged as a significant predictor of mental health. Camouflaging also predicted poorer mental health when not considering autistic traits, and the addition of autistic traits did not improve the model. These findings suggest that, in the current sample, it is the self-reported camouflaging of autistic traits which is associated with poor mental health in non-autistic adults, rather than autistic traits themselves. This finding is accompanied by differences based on gender, whereby women reported poorer mental health and a stronger relationship between mental health and camouflaging.

Our results add to the growing body of literature linking camouflaging to detrimental mental health consequences. This finding is in line with the observation that non-autistic adults who experience social difficulties report utilising similar compensatory strategies as autistic adults and that camouflaging in non-autistic adults is associated with social anxiety, and poorer mental wellbeing.[15,45] While previous research has supported a direct link between autistic traits and poor mental health in non-autistic adults, these studies suggest that camouflaging may also be an important part of this relationship. This suggestion is supported by a recent qualitative study on autistic identity and stigma which asserted that, contrary to suggestions in previous research, suffering is not inherent to autism.[46] Rather, autistic suffering results from being neurodivergent in a neurotypical world which demands conformity, and the discrimination, isolation, and victimisation resulting from this. However, given the small sample size of the current study these results cannot be taken as strong evidence that autistic traits themselves are unrelated to mental health.

The discussed results should be considered within several limitations. First, the results can only report on associations between mental health and camouflaging and do not establish any causality. The measurement of autistic traits in the current study, a single summed score derived from the AQ, also

limits more fine-grained interpretation of the relationship between autistic traits, camouflaging, and mental health. Cluster analysis research indicates non-autistic adults with high AQ scores can be divided into two qualitatively distinct groups based on the combination of social and non-social traits.[47,48] Additionally, several studies of the AQ have failed to support a unidimensional structure of the scale.[49–52] This has important implications for camouflaging research as it may be the presence of specific autistic traits which motivates camouflaging, and this distinction would be obscured by summed scores. Additionally, the moderate collinearity between autistic traits and camouflaging may also be clouding the association between autistic traits and mental health. Future work should examine the role of various demographic factors which may be of importance in the relation between camouflaging and mental health, such as race/ethnicity, and sexual identity. Our sample also had an unbalanced number of women and men (72 women, 32 men) which complicates the interpretation of the relationship of gender to camouflaging and mental health. Finally, it has been suggested that some items on the CAT-Q, the measurement of camouflaging used in the current study, may be confounded by social anxiety.[53,54] Accordingly, there may be some overlap with the measurements of mental health symptomology and camouflaging used in the current study.

Conclusion

We found that camouflaging contributes to experiences of anxiety, depression, and stress. This effect eclipsed the influence of self-reported autistic traits. This finding contributes to the known relationship between autistic traits and mental health in non-autistic adults, demonstrating that camouflaging also plays a role in this relationship. Consistent with research in autistic people, this suggests camouflaging is an important construct in mental health and wellbeing for practitioners in mental health to consider. The role of autistic traits as an independent risk factor for poor mental health should be reconsidered in a framework incorporating the construct of camouflaging. Our work highlights important similarities between autistic and non-autistic people, although more research is needed to assess whether camouflaging is qualitatively similar between autistic and non-autistic people.

Authorship Contribution Statement

M.S., S.M., and S.F.W. all conceived and designed the study. M.S collected the data. M.S analysed the data. M.S prepared the original draft of the manuscript, S.M., and S.F.W reviewed and edited drafts of the manuscript. All authors reviewed and approved the final draft of the manuscript before submission. This article has been submitted solely to this journal and is not published, in press, or submitted elsewhere.

Conflict of Interest

The authors declare that they have no conflict of interests.

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Table 1: Regression Models

	Step 1				Step 2				Step 3			
	B (95% CI)	SE B	β	*t*	*B (95% CI)*	SE B	β	*t*	*B (95% CI)*	SE B	β	*t*
AQ	0.919 (0.505, 1.333)	0.283	0.39	3.243 **	-0.03 (-0.574, 0.513)	0.28	-0.013	-0.109	0.121 (-0.402, 0.643)	0.297	0.053	0.408
CAT-Q					0.456 (0.268, 0.644)	0.086	0.56	5.286**	0.434 (0.255, 0.613)	0.086	0.549	5.073**
Gender									-10.544 (-17.794, -3.294)	3.727	-0.23	-2.829*
CAT-Q:Gender												
Adj. R²	0.144				0.290				0.357			
F	19.34**				23.24**				20.03**			
ΔR²					0.146				0.067			
ΔF					25.163**				8.325*			

	Step 4				Step 5				Step 6			
	B (95% CI)	SE B	β	*t*	*B (95% CI)*	SE B	β	*t*	*B (95% CI)*	SE B	β	*t*
AQ	0.065 (-0.453, 0.582)	0.29	0.028	0.225	0.05 (-0.477, 0.583)	0.298	0.023	0.178	0.105 (-0.410, 0.620)	0.294	0.046	0.358
CAT-Q	0.508 (0.318, 0.699)	0.095	0.643	5.349**	0.492 (0.294, 0.690)	0.098	0.622	5.034**	0.464 (0.289, 0.641)	0.087	0.588	5.336**
Gender	17.92 (-11.04, 46.88)	13.725	0.390	1.306	18.161 (-11.199, 47.521)	14.364	0.392	1.264				
Gender:CAT-Q	-0.319 (-0.633, -0.004)	0.168	-0.649	-1.894	-0.309 (-0.627, 0.010)	0.172	-0.620	-1.790	-0.130 (-0.208, -0.53)	0.044	-0.265	-2.989*
Age					-0.095 (-0.323, 0.132)	0.109	-0.071	-0.875				
Adj. R^2	0.378				0.371				0.373			

F	16.49**				12.93**				21.38**			
ΔR²	0.021				-0.006				0.083			
ΔF	4.05*				0.69				11.06**			

*$p < 0.05$, **$p < 0.001$, N = 110 (Step 1 & 2), N = 104 (Step 3, 4, & 6, N = 102 (Step 5)*

Figure Legend:

Figure 1: Relationship between camouflaging (CAT-Q Score) and mental health symptoms (DASS Total Score) in Men & Women