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Gender matters for daily depression: Symptom fluctuations and links to self-expression

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Abstract

Background: Depression is a global health burden, disproportionately affecting women. A lack of contextual, real-life assessments considering the oft-gendered context (e.g., expression) of daily symptom fluctuations may contribute to this disparity. The current study examines: a) gender differences in daily depressive symptoms – and fluctuations; and b) daily links between self-perceived gender expression and depressive symptoms.

Methods: Established adults ($N = 96$; $M_{age} = 28.19$, $SD_{age} = 8.43$) participated in an ecologically-valid multi-wave 100-day intensive longitudinal study. They reported daily on their depressive symptoms, and on their self-expression in the final study wave. Gender differences in daily symptoms fluctuations (intraindividual standard deviations) and their links to gender expression (person-specific residualized correlations) were examined.

Results: Women experienced greater day-to-day symptom fluctuations than men, after accounting for the gender difference in baseline symptoms ($b = -0.05$; 95 % CI: [−0.093, −0.012]). Results from a subsample ($n = 28$) showed that daily links between gender expression and depressive symptoms were heterogeneous: For 38.5 % of men and 53.3 % of women, daily increases in congruent gender expressions (i.e., masculine for men and feminine for women)

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CRediT authorship contribution statement

Ran Yan: Writing – original draft, Formal analysis, Data curation. **Natasha Chaku:** Writing – review & editing, Data curation, Conceptualization. **Nestor L. Lopez-Duran:** Writing – review & editing, Conceptualization. **Patricia J. Deldin:** Writing – review & editing, Conceptualization. **Adriene M. Beltz:** Writing – review & editing, Writing – original draft, Supervision, Formal analysis, Conceptualization.

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Supplementary materials

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corresponded with daily symptom decreases, but many individuals (46.4 %) did not show meaningful relations.

Conclusions: Results highlight the utility of intensive longitudinal approaches for the study of depression and, for some people, the daily psychological relations with gender self-perceptions. Results also emphasize heterogeneity in depression etiology and the need for personalized basic and applied science.

Limitations: Future research on individuals with varying gender identities and clinical experiences is needed.

Keywords

Depressive symptoms; Established adulthood; Femininity; Intensive longitudinal study; Masculinity; Person-specific

1. Introduction

Depression affects approximately 280 million people worldwide, and its debilitating and life-threatening nature represents a significant global health concern (World Health Organization, 2021). Depression etiology is complex, multilayered, and gendered.[1] Women exhibit a higher lifetime prevalence of depressive disorders than men emerging during early adolescence, persisting across the lifespan, and generalizing across race, ethnicity, and nationality (Kessler, 2003; Salk et al., 2017; Sloan and Sandt, 2006; Weissman et al., 1977). Indeed, gender disparities are evident in various aspects of depression, including symptomatology. For example, women (21.8 %) report more frequent symptoms than men (15.0 %; Burt and Stein, 2002; Villarroel and Terlizzi, 2020). Despite recommendations to understand the transdiagnostic processes underlying depression (Insel et al., 2010), the gendered nature of daily experiences of symptoms – and fluctuations in symptoms – is largely unknown. This gap is partly due to the paucity of intensive longitudinal studies that consider gender in the frequent, repeated assessment of symptoms over short time periods, which are crucial for capturing personalized experiences. Indeed, understanding how gendered concepts coincide with depressive symptoms in everyday life for unique individuals could ultimately help tailor treatments targeting identity-related stressors and reduce the burden of depression for all. Thus, this multi-wave, 100-day intensive longitudinal study examined gender differences in depressive symptom fluctuations that occur in everyday life, and explored personalized links between those symptoms and daily experiences of masculinity and femininity.

1.1. Gender and depressive symptom fluctuations

Changes over long – and even short – periods of time are evident in many aspects of depression that show gender differences. Depression is not static, and symptoms fluctuate in real-time linked to daily experiences (Brose et al., 2015; Hankin et al., 2005;

[1]Gender reflects a biopsychosocial construct that is ‘rooted in biology and shaped by environment and experience’, according to the Institute of Medicine (US) Committee on Understanding the Biology of Sex and Gender Differences (2001). Thus, in this paper, ‘gender/gendered’ is used as an umbrella term for sex- and gender-related variation.

Vandenkerckhove et al., 2021; Wichers, 2014). For example, daily depressive moods can be exacerbated by stress, poor sleep, or negative interactions, and alleviated by exercise and positive social interactions – all in gendered ways (Cavanagh et al., 2017; Pemberton and Fuller Tyszkiewicz, 2016). Intensive longitudinal studies in patients with major depressive disorders (Groen et al., 2019; Krpan et al., 2013; Myin-Germeys et al., 2009; Telford et al., 2012), have provided many important insights into symptom presentation, trajectories, and treatment. The extent to which clinical findings about fluctuations generalize to dimensional symptom presentation (e.g., in individuals from community samples), however, is unclear (Hankin et al., 2005; Vandenkerckhove et al., 2021). Moreover, the role of gender has not been robustly investigated, and links with daily experiences – marking aspects of gender crucial for understanding the social-self in dimensional symptomatology – are only emerging.

Exemplifying these points, in one 35-day study (Hankin et al., 2005), 210 young adults aged 18–23 years reported daily on nine depressive symptoms (from the DSM-4; American Psychiatric Association, 1994) and cognitive styles concerning the most negative event experienced that day. Findings from hierarchical linear models linked temporal changes in depressive symptoms to variations in inferences about negative events; in other words, depressive symptoms changed in concert with participants' interpretations of negative life events. This work leaves questions about *the unique gendered experiences of individuals* unanswered, though, as inferences were drawn from between-person factors, depressive symptom fluctuations over study days were not assessed, and gender was not considered.

Moreover, a weeklong diary study involving 121 Belgian adolescents, examined the association between daily depressive symptoms, self-criticism, dependence, and psychosocial needs (Vandenkerckhove et al., 2021). Participants completed the six-item version of the Center for Epidemiologic Studies-Depression Scale (Radloff, 1977) for seven consecutive days, among other measures. Multilevel models (adjusted for gender and age) showed apparent variations in daily symptoms, which were significantly associated with fluctuations in self-criticism, dependency, and psychosocial needs. Statistically controlling gender, however, follows precarious assumptions that gender differences are quantitative, linear, and do not interact with other study variables (Beltz et al., 2019). Moreover, the study was limited to seven days, which is unfortunately insufficient for person-specific analyses and inferences.

These provocative studies provide evidence that depressive symptoms fluctuate on a daily basis and that this fluctuation may be clinically relevant in community samples. Yet, the personalized experience of symptom fluctuations has largely gone uninvestigated, and there has been virtually no consideration of the ways in which gender, including self-expression, might matter for such processes.

1.2. Gender expression and depression

Gender expression, as one aspect of gender, concerns how an individual manifests their gender self-concept, such as in their perceived masculine or feminine appearance and behavior. Although tradtionally considered stable (Bem, 1974; Spence, 1984), important perspectives emphasize the multidimensional and fluid nature of gender expression; indeed,

feminine and masculine self-perceptions have been shown to vary day-to-day for the vast majority of cisgender folks (Beltz et al., 2021). Gender expression is critical for adjustment, including depressive symptoms (Beltz et al., 2021; Egan and Perry, 2001; DiDonato et al., 2012; Hyde et al., 2019; Nielson and Beltz, 2021; Puckett et al., 2016; Ruble et al., 2006). In fact, the gender congruence hypothesis (Lubinski et al., 1981; Whitley, 1985, 1983) posits that gender congruent self-perceptions (i.e., high femininity and low masculinity for women, and vice versa for men) correlate with psychological well-being. This hypothesis generally echoes psychological principles of inclusion and contentment. For instance, perceived gender congruence elicits positive social responses (e.g., increased acceptance: Roberts et al., 2013; Smith and Leaper, 2006; Tabler et al., 2021; Yunger et al., 2004) and to reflect opportunities for identity alignment (DiDonato and Berenbaum, 2013, 2011; Egan and Perry, 2001).

Most work on the gender congruence hypothesis has utilized cross-sectional data and a between-person approach, assuming that the mean for each gender equally applies to all individual members of that gender, who only randomly vary from each other (Beltz et al., 2016; Molenaar, 2004). This is a crucial limitation, as for instance, self-perceptions of masculinity might be associated with reduced depressive symptoms for men – *on average* – but not for each *individual* man, especially those for whom masculine self-perceptions are not core to their identities. An idiographic approach, however, does not make this assumption because it leverages intensive longitudinal data to detect person-specific effects (Beltz et al., 2016; Molenaar, 2004).

One study has examined the links between daily fluctuations in gender expression and internalizing problems across 75 days in cisgender young adults (Beltz et al., 2021). Sample-level averages did not describe individuals well, consistent with expectations for heterogeneous psychological processes like gender expression and adjustment (Molenaar, 2004). Specifically, between-person effects from multilevel models showed that daily gender expression was significantly related to internalizing problems, such that decreases in masculinity were associated with daily adjustment declines for men (but not women). However, person-specific correlations showed 19 % of men experienced improved adjustment with daily decreases in masculinity, highlighting individual differences. This work, however, was limited to a healthy young adult university sample, restricting generalizability.

1.3. Current study

The current study thus examines: (a) gender differences in depressive symptom fluctuations in a community sample of cisgender men and women (ranging in baseline depressive symptomatology) in established adulthood; and (b) whether daily variations in depressive symptoms link to a key aspect of gender (i.e., gender expression) in person-specific ways. This was achieved by using two 100-day waves from an ecologically valid intensive longitudinal study, reflecting nearly 10,000 daily reports. Daily depressive symptoms and gender expression were expected to fluctuate meaningfully across days. Given the limited extant literature, there were not directional hypotheses for gender differences, but daily links between depressive symptoms and gender expression were expected. Consistent with the

gender congruence hypothesis (about averages) and findings from past intensive longitudinal work (about individuals), fewer symptoms on days men reported greater gender-congruent expressions (e.g., high masculinity) were expected for many, but not all, men. There were not expectations for a consistent pattern between gender expression and depressive symptoms in women (on average or for individuals).

2. Methods

Data come from a multi-wave 100-day intensive longitudinal study collected in 2018–2022. Subsets of data have been previously used as methodological illustrations (Luo et al., 2023; Weigard et al., 2023). Data on depressive symptoms and gender expression are novel and come from the intake, first 100-day wave, and third 100-day wave. The study protocol was approved by the Institutional Research Board for Health Sciences and Behavioral Sciences at the University of Michigan.

2.1. Participants

Participants were recruited through university subject pools, email announcements, social media, and community flyers. Interested individuals first completed a brief online survey on Qualtrics, which included mental health measures (e.g., Patient Health Questionnaire-9, Kroenke et al., 2001). Approximately equal numbers of self-identified men and women ranging in symptomatology were then invited to participate. Potential participants were not excluded based on gender identity, however, all individuals in the sample identified as cisgender.

The sample providing intake and initial 100-day data (wave 1) included 96 participants (45 self-identified women and 51 self-identified men) between 18 and 45 years old ($M = 28.19$, $SD = 8.43$). Participants were primarily non-Latine (93 %); they identified as White (58 %), Asian (21 %), Black/African American (13 %), American Indian/Alaskan Native (1 %), or multiple races (5 %), with 2 % not indicating race. A subset of these participants ($n = 32$) completed an additional 100-day wave (wave 3), consisting of 17 women and 15 men who were aged 21 to 49 years old ($M = 31.44$, $SD = 8.09$). Most identified as White (60 %) and non-Latine (93 %), with others self-reporting as Asian (23 %), Black/African American (16 %), or multiple races (1 %). Women and men did not significantly differ in key demographic characteristics in wave 1 or wave 3 (see details in Supplementary Materials).

Only participants with daily response rates of at least 80 % on the measures utilized in this study were included in analyses, following timeseries simulations relating to data fidelity and missingness as well as precedent in clinical ambulatory assessment research (Beltz et al., 2021; Rankin and Marsh, 1985; Wright et al., 2019). Of the 130 participants who completed the intake and first 100-day wave of the study, 34 (26 %) had a daily response rate below 80 % and were excluded from analyses. Of the 37 participants who completed the third 100-day wave of the study, 5 had a response rate below 80 % and were excluded. Thus, the average response rates were 94 % for wave 1 and 96 % for wave 3. Details about excluded participants are in Supplementary Materials.

2.2. Procedures

Participants first attended a 90-min laboratory session, completing a computerized survey through Qualtrics to provide demographic details and a baseline depression assessment. The next day, participants started the first wave of the intensive longitudinal study. Specifically, they reported daily – for 100 days – their thoughts, feelings, and experiences over the past 24 h, including their depressive symptoms via online Qualtrics surveys. Internet-compatible surveys were accessible every evening after 5:00PM via emailed links, and were to be completed after 8:00PM or before bedtime. The link expired at noon the next day. Data were collected from October 2018-January 2020.

Participants with at least 80 % response rates who consented to future studies were invited for subsequent waves. Specifically, wave 3 was open to those who were at least 21 years old, and used surveys similar to wave 1, with the addition of a daily gender expression measure. Data were collected in Summer 2022. Compensation details for all study waves are provided in the Supplementary Materials.

2.3. Measures

2.3.1. Intake depressive symptoms—Participants completed the 20-item Center for Epidemiologic Studies-Depression Scale (CES-D), assessing symptoms (e.g., “I thought my life had been a failure”) over the past week (Radloff, 1977) on a four-point Likert scale (0 = *Rarely or None of the Time* to 3 = *Most or Almost All the Time*). The measure is well-established in research and clinical settings with excellent validity and reliability (Eaton et al., 2004; Weissman et al., 1977), including internal consistency ($\alpha = 0.93$) at intake in the current study. Sum scores, ranging from 0 to 60, were calculated after reverse coding items, excluding cases with >4 missing items following validated scoring instructions (Radloff, 1977). Scores ≥16 suggest risk for clinical depression (Weissman et al., 1977).

2.3.2. Daily depressive symptoms—During the 100-day responses of waves 1 and 3, participants also completed a version of the CES-D, modified to reflect symptoms over the past 24 h, on a four-point Likert scale (0 = *Rarely or None of the Time: <1 h* to 3 = *Most or Almost All the Time: 5 or more hours*). Similar measures have been adapted and used in other intensive longitudinal studies (e.g., Vandenkerckhove et al., 2021). The measure showed good reliability in the current study, according to multilevel confirmatory factor analysis (Schuurman and Hamaker, 2019), with $\Omega_{between} = 0.96$ and $\Omega_{within} = 0.84$ in wave 1, and $\Omega_{between} = 0.96$ and $\Omega_{within} = 0.86$ in wave 3.

After reverse coding, mean scores were calculated daily for each participant, allowing for up to 4 missing items. Intraindividual means (i*M*s) and standard deviations (i*SD*s) across all 100 days were computed for each participant. An i*SD* near zero indicates little daily fluctuation, whereas values significantly above zero signify consistent fluctuation or notable deviations on some days.

2.3.3. Daily gender expression—Only in wave 3 didparticipants reported on their daily self-perceived gender expression in a six-item questionnaire (Storms, 1979), rating how masculine (e.g., “How masculine was your personality today?”) and feminine (e.g.,

"In general, how feminine do you think you were today?") they felt, acted, and appeared in the past 24 h, using a five-point Likert scale (1 = *Not at All* to 5 = *Extremely*). Specific definitions for 'masculine' and 'feminine' were not provided; instead, if they asked, participants were instructed to use their own interpretations, consistent with the self-perceived measure.

Daily composite scores were derived by reverse coding the femininity items and merging them with the masculinity items, yielding a bipolar, unidimensional gender expression score from 1 (high femininity) to 5 (high masculinity). This approach aligns with continuum-based gender identity theories (Castleberry, 2019; Monro, 2019) and recent empirical studies (Beltz, 2018; Beltz et al., 2021; Gülgöz et al., 2019). The six-item measure was reliable with $\Omega_{between} = 0.76$ and $\Omega_{within} = 0.77$ (Schuurman and Hamaker, 2019). Recognizing theories and measures (Antill et al., 1993; Bem, 1974) that view masculinity and femininity as conceptually distinct, however, daily means were also computed separately for the three-item masculinity and femininity subscales to be used in exploratory analyses.

2.4. Analysis plan

After examining gender differences in intake depressive symptoms, two sets of analyses were conducted to address the main research questions. Multiple regression analyses examined whether gender (0 = women and 1 = men) was associated with daily depressive symptoms (i*M*s) and their 100-day fluctuations (i*SD*s), accounting for baseline symptoms, and seasonality (in a supplementary analysis) using intake and wave 1 data. Type I error was 0.05.

To examine person-specific links between daily depressive symptoms and gender expression, wave 3 data were used. First, gender differences in daily expression averages (i*M*s) and fluctuations (i*SD*s) were tested after examining whether gender expression fluctuated significantly across days (via a one-sample *t*-test on i*SD*s). Next, a pairwise residualized correlation of daily depressive symptoms and feminine-to-masculine gender expression was estimated for each individual who evidenced daily fluctuations in these variables, following established procedures (see Box et al., 2015; Heath, 2014); for each variable, present-day scores were regressed on previous-day scores, and residuals were correlated with each other to reflect the daily synchrony between gender expression and symptoms, consistent with past work (Beltz et al.,2021). The smallest effect size of interest (SESOI) was $r = 0.10$ (Cohen, 1988), and the direction of the associations (with participant gender) reflected gender congruence, with positive correlations implying a congruent effect for women, and negative correlations implying a congruent effect for men. To facilitate inferences about whether daily gender congruence is associated with overall mental health, the residualized correlations were then linked to average daily depressive symptoms (i*M*s), separately for men and women. Exploratory analyses utilizing the same procedures were conducted, replacing the feminine-to-masculine continuum with separate femininity and masculinity scores.

3. Results

Forty-four percent of the sample (51 % women, 37 % men) had clinically significant depression risk (i.e., ≥16 on intake CES-D). In fact, the sample-average baseline depression score was about 16, with notable variability (M = 16.38, SD = 12.00, range: 0–58). Gender differences were also present. As expected and compared to men (M = 14.12, SD = 10.63), women (M = 18.93, SD = 13.04) reported more depressive symptoms at intake, with a moderate effect size, $t(94) = 1.99$, $p = .049$, $d = 0.41$.

3.1. Gender differences in daily depressive symptoms

Multiple regression models examining gender differences in depressive symptoms were significant for both daily averages (iM), $F(3,92) = 57.90$, $p < .001$, $R^2 = 0.56$, and fluctuations (iSD), $F(3,92) = 29.69$, $p < .001$, $R^2 = 0.39$, but gender differences, $b = -0.053$, $SE = 0.02$, $p = .011$, were only significant in the latter model, such that women (M = 0.30, SD = 0.13) reported more symptom fluctuations than men (M = 0.22, SD = 0.11), after accounting for significant baseline symptoms, $b = 0.006$, $SE = 0.001$, $p < .001$. Women (M = 0.62, SD = 0.42) and men (M = 0.52, SD = 0.39) did not significantly differ in average daily symptoms, $b = 0.021$, $SE = 0.057$, $p = .710$, after accounting for significant baseline symptoms, $b = 0.025$, $SE = 0.002$, $p < .001$. Models exploring potential seasonality yielded similar inferences (see Supplementary Materials). Thus, depressive symptom fluctuations provide information about the gendered nature of depression above and beyond levels of symptoms.

Symptom fluctuations (iSDs) ranged from 0.06 to 0.63 (M_{iSD} = 0.26, SD_{iSD} = 0.12), indicating significant daily fluctuations, as shown by a one-sample t-test, $t(95) = 20.42$, $p < .001$, $d = 2.08$. This notable within-person variation is visible in the overall sample. Thin lines in Fig. 1 depict each individual's daily symptoms over 100 days, showing more pronounced average symptoms (thick solid lines) and fluctuations (thick dashed lines) in women (red) compared to men (blue). Fig. 2 further illustrates this heterogeneity with four person-specific plots. For instance, despite low baseline symptoms (CES-D < 16), participants A (woman) and B (man) had contrasting symptom fluctuations; participant A had smaller (iSDs < 0.26) and participant B had larger fluctuations (iSD ≥ 0.26). Likewise, participant C (woman) with high baseline symptoms showed greater daily symptoms and fluctuations than participant D (man).

3.2. Person-specific links between daily gender expression and depressive symptoms

As expected in wave 3, men (M = 3.62, SD = 0.70) and women (M = 2.18, SD = 0.65) differed significantly in their average gender expression across study days (iM; on the feminine-to-masculine continuum), $t(30) = -6.00$, $p < .001$, $d = 2.13$. Fluctuations in gender expression (iSDs) were also significant, $t(31) = 6.42$, $p < .001$, $d = 1.14$. iSDs ranged from 0 to 1.28 (M_{iSD} = 0.28, SD_{iSD} = 0.25),[2] with 87.5 % of the sample reporting fluctuation. There was not a gender difference in expression fluctuations, $t(30) = 0.45$, $p = .658$, $d = 0.16$.

[2]Two women and two men did not report fluctuations in expression across the 100 days. They were excluded from subsequent person-specific analyses. Two additional individuals had variation in their feminine-to-masculine scores, but not in their masculinity scores when it was explored as a separate dimension; thus, they were only excluded from analyses concerning masculinity.

Daily residualized correlations between depressive symptoms and feminine-to-masculine gender expression ranged from −0.51 to 0.44 (M = −0.002, SD = 0.20). Although the average correlation was nearly zero, 53.6 % of participants showed a meaningful relationship exceeding the SESOI, indicating heterogeneity. Fig. 3 illustrates this with daily gender expression and depressive symptoms for 5 participants, along with their iMs and iSDs. For instance, participant E (woman) showed a gender congruent effect, with a synchronized daily pattern: on days with higher femininity (lower expression scores), she reported fewer depressive symptoms. Conversely, participant F (man) reported fewer symptoms on days with higher masculinity. Participants G and H showed no significant relationship between gender expression and symptoms. Uniquely, participant I (woman) showed a gender incongruent effect, with fewer symptoms on days with higher masculinity – a pattern not observed in any man.[3]

The lack of gender incongruent effects for men is also evidenced in the first data row of Table 1 and on the right of Fig. 4, which displays person-specific residualized correlations between gender expression and depressive symptoms for wave 3 participants. Each point represents a unique individual's 100-day correlation, with women (solid triangles) on the left and men (open triangles) on the right. The dashed lines denote the SESOI, and the shaded areas denote gender congruent effects (i.e., days of high femininity-to-masculinity and low depression for men, and vice versa for women). Notably, 53.3 % of women showed positive correlations, aligning with the gender congruence hypothesis: lower daily femininity-to-masculinity levels correlated with fewer symptoms. Among men, 38.5 % exhibited inverse correlations, also supporting the hypothesis: increased daily femininity-to-masculinity levels were linked to fewer symptoms. However, 33.3 % of women and 61.5 % of men showed no systematic link between gender expression and daily symptoms, including two women (13.3 %) for whom low femininity-to-masculinity correlated with fewer symptoms. Importantly, daily depressive symptoms iMs did not significantly correlate with residualized correlations for men (r = 0.34, p = .257) or women (r = 0.37, p = .171), indicating that participants who showed a gender congruent effect did not have overall higher or lower levels of symptoms.[4] In fact, the positive correlation observed in women, though not statistically significant, suggested that stronger daily gender congruent effects were actually associated with heightened levels of depressive symptoms across the 100 days of wave 3.

Table 1 also presents exploratory results considering masculinity and femininity as separate dimensions. Gender congruent effects were found in 60.0 % of women for whom increased femininity correlated with fewer depressive symptoms, and in 50.0 % of men for whom increased masculinity showed the same pattern. However, the pattern was less evident in opposite gendered dimensions (masculinity in women and femininity in men). For most women (64.3 %) and men (69.2 %), these dimensions were not significantly linked to daily depressive symptoms.

[3]One man evidenced a gender incongruent effect when masculinity and femininity were considered separately.
[4]Analyses exploring masculinity and femininity as separate dimensions yielded the same pattern of results.

4. Discussion

Using nearly 10,000 reports of depressive symptomatology as participants went about their day-to-day lives, this study provides an ecologically valid and novel perspective on daily symptom fluctuations and their gendered nature. Specifically, the role of gender, and its expression, in the daily ebb and flow of depressive symptoms was investigated among established adults varying in symptom severity.

4.1. Women experience greater fluctuations in daily depressive symptoms than men

Research on daily depressive symptom fluctuations is limited, yet consistent in reporting important variations over short periods of time (Hankin et al., 2005; Hosenfeld et al., 2015; Vandenkerckhove et al., 2021; Wichers, 2014). The current findings support and extend this research by incorporating gender, revealing that women experienced greater daily fluctuations than men over 100 days – above and beyond baseline levels. These findings increase understanding of depression's gendered presentation and may ultimately inform its etiology or treatment. Regarding etiology, gender differences in symptom fluctuations likely relate to differences in other aspects of depression, such as mood and cognitive style (Hankin, 2009; Hankin et al., 1998; Nolen-Hoeksema, 2012). Gonadal hormone links to depression fluctuations also cannot be ruled out, despite recent mixed findings (Beltz et al., 2021; Freeman et al., 2006), which likely reflect heterogeneity in the neuroendocrinology of depression. Regarding treatment, clinical studies show that patients with Major Depressive Disorders who have a more fluctuating longitudinal course of illness tend to have poorer functioning and lower quality of life than those with a relatively stable course (Vergunst et al., 2013). Therefore, women might benefit more than men from leveraging established treatment strategies focused on stability, such as regulating circadian function through light therapy, structured social routines, and medication (Wirz-Justice, 2008). Addressing women's unique symptom patterns could reduce the overall gender disparity in depression.

No gender difference was observed in average daily depressive symptoms assessed over 100 days. Although this null effect may seem surprising at first, it likely reflects a strong correspondence between daily mean levels of symptoms and baseline symptoms, which showed a significant gender difference and were controlled in daily analyses. Thus, average daily depressive symptoms did not offer any new insights beyond what was already provided by the baseline assessment. This suggests that lab-based and daily ambulatory symptom reports largely converge, and that the challenges of ecologically-valid assessments may only be worthwhile for some research questions, such as those that explicitly consider fluctuations.

4.2. Links between daily gender expression and depressive symptoms are person-specific

As expected, daily gender expression and depressive symptoms fluctuated across 100-days and were person-specific. The gender congruence hypothesis posits that individuals who possess more gender-congruent *traits* experience better psychological adjustment than those with fewer *traits*, but most tests of the hypothesis fail to consider gendered *states* or heterogeneity across individuals. Combining 100-day data on depressive symptoms with

self-perceived gender expression (on a feminine-to-masculine continuum) in a subset of participants, showed daily correlations consistent with the gender congruence hypothesis – but only for ~53 % of women and ~39 % of men. These person-specific results partially corroborated expectations based on a sample of healthy young adults (Beltz et al., 2021), with similar findings for men, as 42 % evidenced a gender congruent effect, but fewer young adult women (27 %) evidencing the effect. The increased prevalence of the gender congruent effect in the present sample of women could reflect development, as femininity has been shown to increase with transitions that often accompany established adulthood, such as changing marital status (Kasen et al., 2006). More mechanistic work, including considerations of other aspects of gender important for clinical translation, is needed.

Analyses examining separate masculine and feminine dimensions elucidated gender continuum-based findings: 60 % of women and 50 % of men had positive correlations between gender congruent expression (i.e., femininity for women and masculinity for men) and reduced daily depressive symptoms, but similar effects were not seen for gender incongruent expressions (i.e., masculinity for women and femininity for men). This contrasts with young adult data (Beltz et al., 2021), and aligns with theories on gendered personality traits suggesting that high femininity and masculinity is phenotypically distinct from low femininity and masculinity (Antill et al., 1993; Bem, 1974). Despite these consistencies, it is vital to acknowledge that for 33.3 % of women and 61.5 % of men, no meaningful link (i.e., daily residualized correlation below the SESOI) was found between their daily gender expression and depressive symptoms. Two women even reported improved psychological well-being on days they felt more masculine!

To reiterate, the relation between gender expression and mental health is person-specific. As a relation, it does not reflect *levels* of symptoms. In fact, average daily depressive symptoms were not significantly correlated with gender congruence (reflected by daily residualized correlations), meaning that daily gender congruence did not reflect overall better or worse mental health at the sample-level (even though some effects were strong within individuals). Results hinted, though, at the possibility that the daily gender congruent effect might be associated with worse overall mental health for women. This is an important avenue for future work.

Clearly, even for individuals who evidenced a gender congruent effect, these correlational findings do *not* infer that they should conform to perceptions of a stereotypical gender norm to maximize mental health. Links between both gender expression and adjustment could be due to multiple variables that influence and are influenced by both, such as internalized pressure to align with gender norms, perceived consequences of norm violations, and belief systems related to gender (Egan and Perry, 2001; Smith and Leaper, 2006; Tabler et al., 2021; Wu et al., 2022). Consistent with this, the psychological mechanisms underlying the gender congruent effect, which are potentially person-specific, could be similar for other aspects of identity – beyond gender – that are consequential to an individual, reflecting adjustment associated with perceived belonging and inclusion (DiDonato and Berenbaum, 2011; Egan and Perry, 2001). For some individuals, gender expression fluctuations may precede symptom changes (e.g., experiencing more symptoms because they felt more masculine than usual). For others, symptom changes may lead

to shifts in gender self-perceptions (e.g., feeling less gender-typical due to a depressive symptom spike). Understanding the direction of these effects for each person can then inform future investigations of the underlying mechanisms, such as social triggers and daily stressors. These findings highlight the importance of exploring gender expression as an identity-related stressor impacting daily depression. Personalized interventions integrating gender-related factors (e.g., Pachankis, 2018; Pachankis et al., 2022) or helping patients feel more comfortable with their gendered self-concept (e.g., Glynn et al., 2016; Puckett et al., 2016) should be empirically examined.

4.3. Study considerations and limitations

Several study aspects warrant consideration. The sample is reasonably representative of the population from which it was drawn. There was substantial variation in race/ethnicity, and a wide range of depressive symptomatology, with 44 % of participants reporting clinically relevant symptoms (Weissman et al., 1977). Future investigations recruiting participants with a more diverse range of gender identities and clinical experiences is warranted, though. The person-specific approach has utility in these spaces, as it avoids misrepresenting individuals by comparing them to other assumed-homogenous groups and allows results to generalize to the same individual at future time points within the same context (e.g., social, cultural, and seasonal) by ultimately informing individualized treatments targeting identity-related stressors (Glynn et al., 2016).

There are unique considerations surrounding the intensive longitudinal nature of this study. The 100-day timeframe provided enough power for person-specific analyses despite data missingness (e.g., Rankin and Marsh, 1985), and participants who were not included due to a <80 % response rate did not significantly differ from those who were included on key demographics. Those with <80 % response rates were excluded due to mixed findings regarding optimal imputation approaches for timeseries missing >20 % (see e.g., Liu and Molenaar, 2014). It is possible, though, that participants self-selected into the study based on other characteristics, or that the daily introspection required to report depressive symptoms for 100 days altered their symptom perceptions (i.e., measurement reactivity). Future studies should consider using alternate intensive longitudinal designs (e.g., varying symptom sampling frequency) and analytic strategies (e.g., multilevel models to differentially reflect between- versus within-person variation or network models to delineate interrelations with potential mechanisms).

5. Conclusions

This study examined gender differences in depressive symptom fluctuations and their daily links to individuals' gendered self-perceptions using two waves of 100-day intensive longitudinal data. At the sample-level, established adult women experienced greater day-to-day fluctuations in depressive symptoms than did men. At the individual-level, daily gender congruent expressions were linked to reduced depressive symptoms for *some* individuals, but gender expression did not matter for depression in others, reflecting notable heterogeneity and multiple pathways to mental health. Findings highlight the importance of intensive longitudinal assessments for understanding diverse multimodal constructs like

depression and gender expression. They inform future research on personalized treatment, targeting mechanisms underlying symptom variation and incorporating gender self-concept when it is salient for individuals. Ultimately, such approaches may help reduce the gender disparity in depression and improve wellbeing for all.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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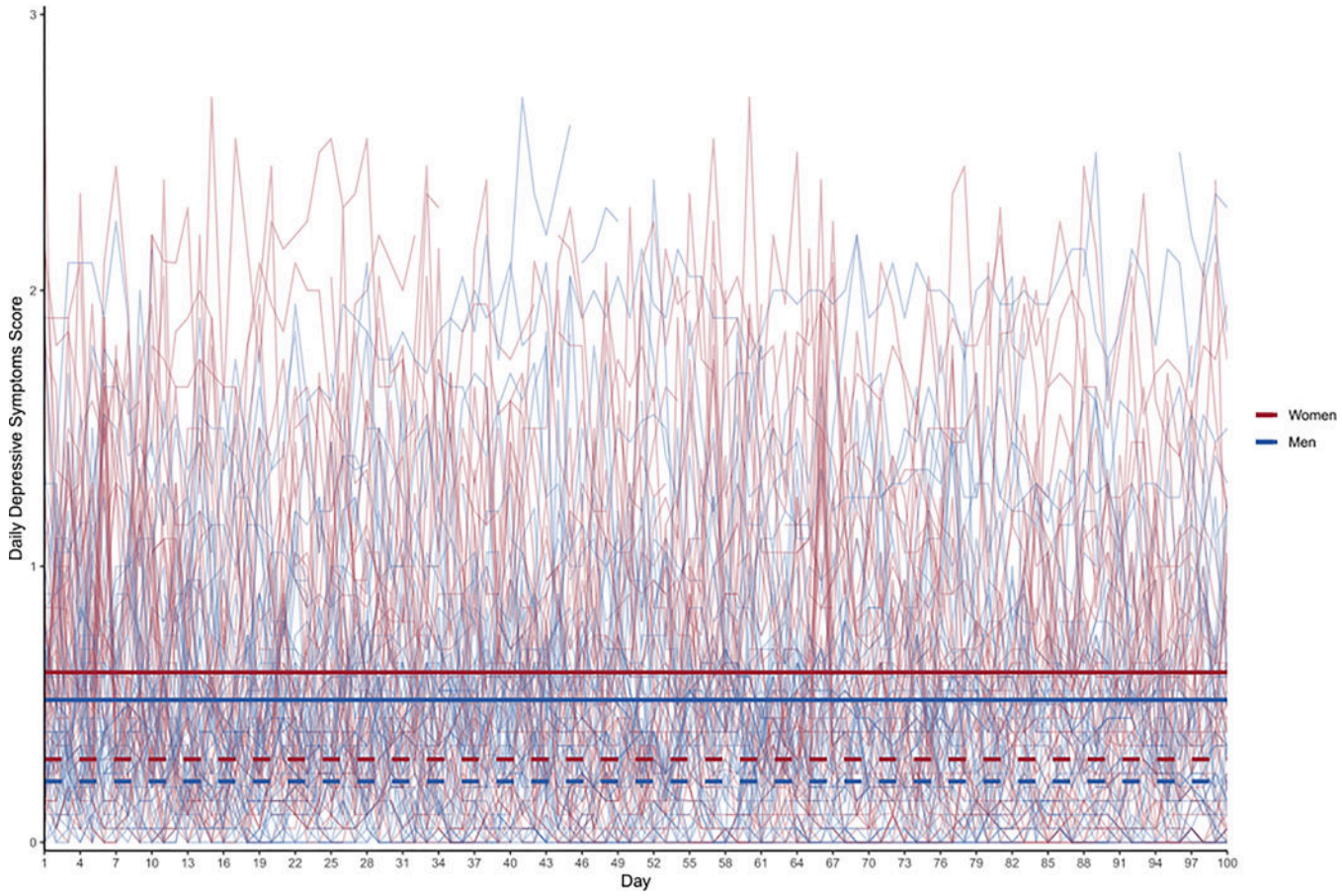

Fig. 1.

Plot of daily depressive symptom scores for individual men (thin blue lines) and women (thin red lines) across 100 days of the study in wave 1. The thick solid lines show the average 100-day depressive symptoms score across all days for all women (red) and for all men (blue). Similarly, the thick dashed lines show the 100-day average variation (i.e., the average i*SD*) across all women (red) and all men (blue).

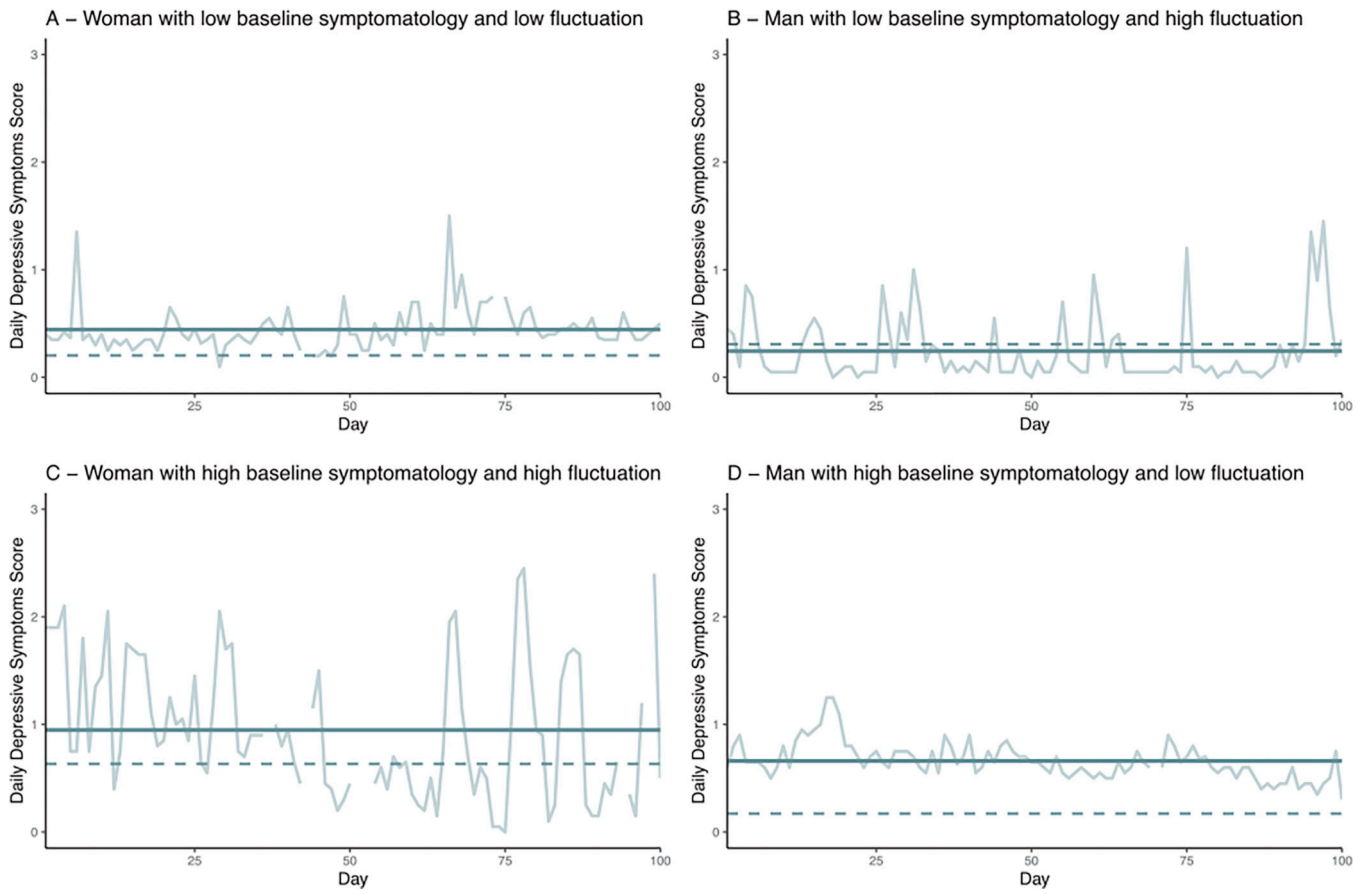

Fig. 2.

Plots of daily depressive symptoms (in thin light green lines) for 4 illustrative individuals across 100 days of the study in wave 1. Thick green solid lines represent each person's average depressive symptoms across 100 days (i*M*), and thick green dashed lines represent each person's fluctuation (i*SD*) around their own mean across 100 days. Individuals are considered to have high baseline symptomatology if their intake score was at or above the clinical risk threshold (i.e., CES-D sum score ≥ 16; Weissman et al., 1977). Individuals are considered to have high fluctuation if they have an i*SD* greater than the sample average (i.e., ≥ 0.26).

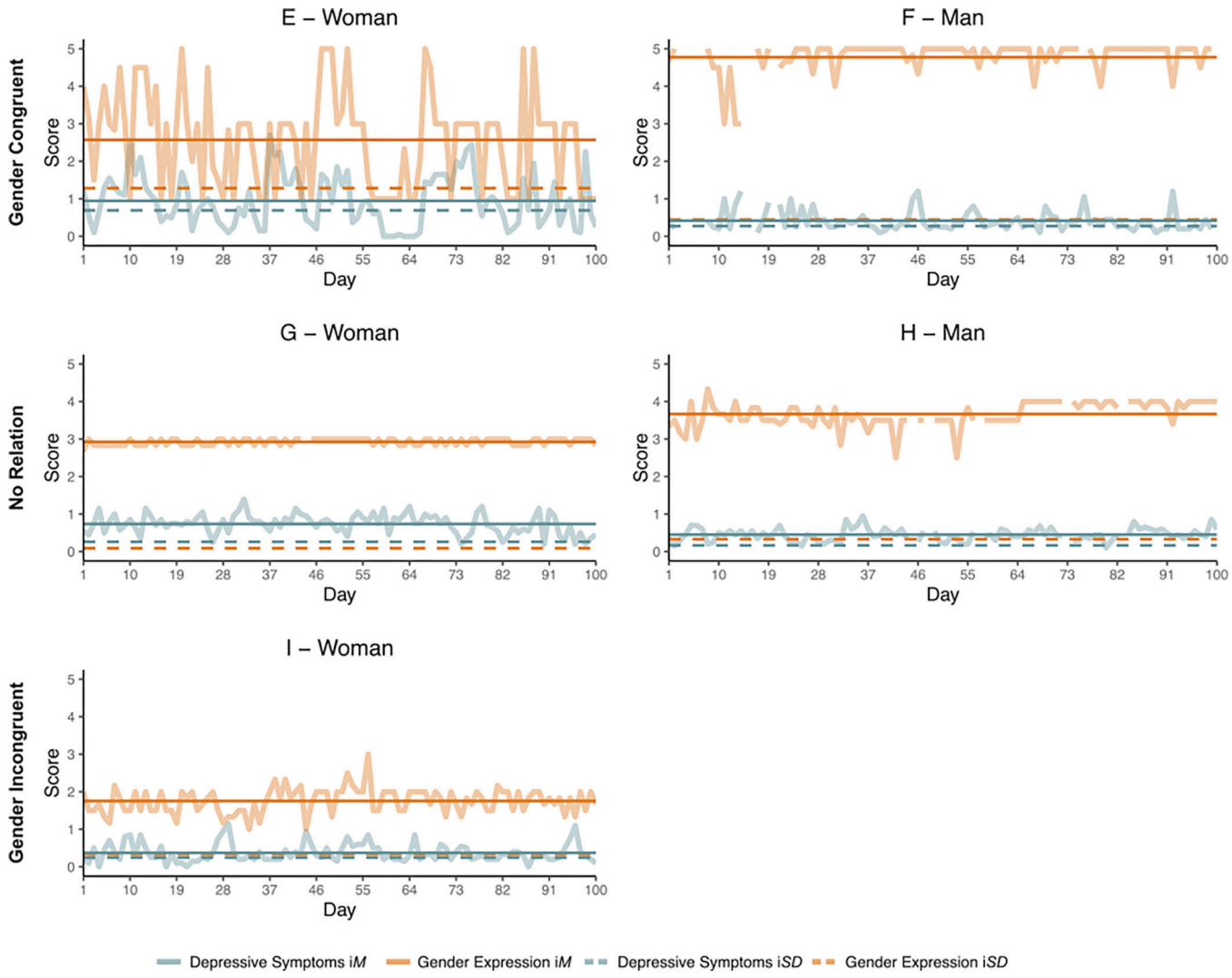

Fig. 3.

Plots of daily gender expression (in light orange) and depressive symptoms (in light green) for 5 illustrative individuals across 100 days of the study in wave 3. Solid horizontal lines represent average scores (i*M*s) across 100 days for gender expression (dark orange) and depressive symptoms (dark green). Dashed horizontal lines represent each person's fluctuation (i*SD*) around their own mean for each variable across 100 days.

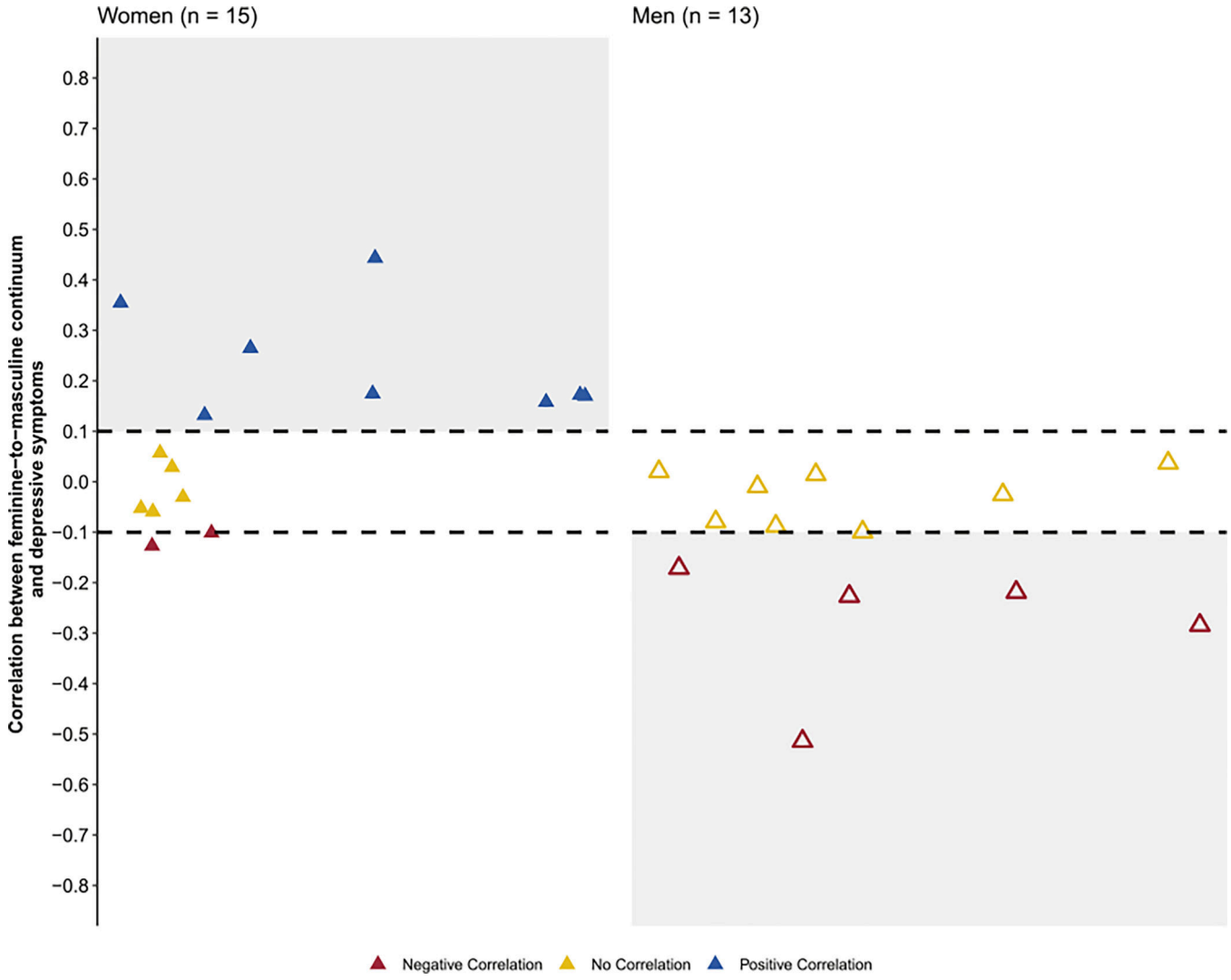

Fig. 4.

Scatterplot depicting person-specific correlations between daily depressive symptoms and feminine-to-masculine gender expression for individuals in wave 3. The x-axis displays individual participants, and the y-axis represents the direction and magnitude of the correlations. Women are denoted by solid triangles on the left, whereas men are denoted by open triangles on the right. Dashed lines at $r = \pm 0.10$ indicate boundaries for the smallest effect size of interest, with 46.4 % of all participants falling within this range (yellow triangles). Blue triangles above the dashed lines indicate positive correlations, reflecting gender congruent effects for 53.3 % of women. Red triangles below the dashed lines signify inverse correlations, corresponding to gender congruent effects for 38.5 % of men.

Table 1

Descriptive statistics for person-specific correlations between daily gender expression (reflected three ways) and depressive symptoms.

Correlation	Women							Men						
	n	Range	M	SD	Gender Congruent Effects	No Relation	Gender Incongruent Effects	n	Range	M	SD	Gender Congruent Effects	No Relation	Gender Incongruent Effects
Feminine-to-masculine continuum and Depression	15	−0.13,0.44	0.11	0.17	53.3 %	33.3 %	13.3 %	13	−0.51,0.04	−0.13	0.16	38.5 %	61.5%	0.0%
Masculinity and Depression	14	−0.31,0.44	−0.03	0.18	7.1 %	64.3 %	28.6 %	12	−0.54,0.15	−0.14	0.20	50.0 %	41.7%	8.3 %
Femininity and Depression	15	−0.43,0.10	−0.15	0.17	60.0 %	33.3 %	6.7%	13	−0.18,0.44	0.06	0.15	23.1 %	69.2%	7.7%

Note. Participants were classified according to the strength and direction of their residualized correlations between gender expression and depressive symptoms, as evidencing: Gender Congruent Effects (Women: $r > 0.10$; Men: $r < -0.10$), No Relations ($-0.10 \leq r \leq 0.10$), and Gender Incongruent Effects (Women: $r < -0.10$; Men: $r > 0.10$). Percentages in the Gender Congruent and Gender Incongruent Effects columns show the participants of each gender with meaningful correlations (i.e., exceeding the smallest effect size of interest: $r = 0.10$; Cohen, 1988). Gender expression was assessed as a feminine-to-masculine continuum (first row correlations with symptoms) and explored as a separate masculine dimension (middle row correlation with symptoms) and feminine dimension (bottom row correlations with symptoms). No correlations were exactly 0.10 or − 0.10.

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