RESEARCH ARTICLE

Daily use of digital technologies to feel better: Adolescents' digital emotion regulation, emotions, loneliness, and recovery, considering prior emotional problems

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Abstract

Introduction: Adolescents report using digital technologies for emotion regulation (digital ER), with the aim of feeling better (i.e., improving emotions and reducing loneliness). In this 7-day diary study, we investigated associations of digital ER, emotions, and loneliness, and tested whether prior emotional problems moderated these associations.

Method: Participants were 312 Australian adolescents (M_{age} = 13.91, SD = 1.52; 44% boys). Daily surveys measured digital ER; end-of-day happiness, sadness, worry, anger, and loneliness; and peak sadness, worry, and anger. End-of day emotions were subtracted from peak emotions to calculate emotion recovery for sadness, worry, and anger. Participants were randomly selected from two symptom strata (high/low) defined by depression and social anxiety measures collected before the diary. Data were analyzed using multilevel path modeling. Cross-level interactions tested whether symptom strata moderated associations.

Results: Digital ER was associated with more recovery from peak to end-of-day sadness and worry, but also with increased sadness, worry, anger, and loneliness by the next end-of-day. Higher end-of-day loneliness was associated with increased next-day digital ER. Prior emotional symptoms were not a significant moderator of daily digital ER and emotion associations.

Conclusion: Adolescents who report more digital ER in a day show more recovery from the peak of negative emotion that day, but this recovery dissipates, with digital ER also associated with increased negative emotion and loneliness by the next day for all adolescents, regardless of prior symptom status. Lonelier adolescents use more digital ER by the next day, suggesting they need support to make social connections—online or offline.

KEYWORDS
daily diary, digital technology use, emotion, emotion regulation, loneliness, psychological health

1 | INTRODUCTION

Digital technologies (e.g., social media, texting, gaming) are an integral part of most adolescents' daily lives (Van Zalk, 2020; Vogels et al., 2022), with the typical adolescent engaging with them for many hours daily (Rideout et al., 2022; Vogels et al., 2022) for a variety of reasons (Leung, 2007; Papacharissi & Rubin, 2000). Given this integration, researchers have

investigated adolescents' amount of technology use and behaviors online as correlates of their well-being and psychosocial development, finding evidence that technology use assists with the development and maintenance of friendships (Yau & Reich, 2020), aids self-expression and identity exploration (Stuart et al., 2022), and is a resource for information and support (Duvenage et al., 2020).

There is also substantial evidence that the use of digital technologies is related to emotionality (Odgers & Jensen, 2020; Oh et al., 2014); it can have negative impacts on emotions, but it may also alleviate distress and promote positive affect through opportunities for social engagement, support, help, and activities. Such findings suggest that digital technologies may be tools for emotion regulation (ER), with ER defined as the process through which individuals manage how and when to experience and express emotions (Gross, 1998). Thus, digital ER more specifically is the use of digital technologies to elicit or control specific emotions and mood states (Blumberg et al., 2016). Indeed, even 20 years ago, work in this arena found that adolescents' internet use may be motivated by stress and negative emotion, including the desire to seek support or help for emotional problems (Gould et al., 2002) and stressful life events (Leung, 2007). However, although emotionality, ER, and seeking help and connection have been described as important motivations for adolescents' technology use (Throuvala et al., 2019; Wadley et al., 2020), digital ER is poorly understood and findings have been mixed about how constructive it is to use digital ER (Modecki et al., 2021, 2023). Given that emotion generation and regulation is a process that unfolds quickly within short periods of time (Gross, 1998; Masters et al., 2023), intensive repeated measures designs are increasingly applied to untangle these questions (Modecki et al., 2021, 2023).

1.1 | Motivations for digital technology use and digital ER

Research is increasingly focused on dissecting the motivations for and ways people employ technologies, rather than only considering general use or time on screens (Odgers & Jensen, 2020). As such, a consensus is emerging that digital technology use and its effects on well-being "depends on how and why people use it" (Kross et al., 2020, p. 55). Reasons for the use of digital technologies are outlined in uses and gratifications theory (UGT; Blumler & Katz, 1974; Papacharissi & Rubin, 2000). UGT describes how individuals selectively use digital technologies to meet different needs including social inclusion and affection (Papacharissi & Rubin, 2000; Whiting & Williams, 2013), information sharing and seeking, and entertainment and relaxation (Whiting & Williams, 2013). Many of these uses appear relevant to the purpose of regulating or changing emotions with the aim of upregulating positive and downregulating negative emotions (Brimmel et al., 2023; van Ingen, Utz, & Toepoel, 2016).

Recognizing adolescents' use of digital ER (and, relatedly, use for coping with stressors), there has been a proliferation of work on the positive and negative roles of digital technologies in the stress–emotion-coping process (Orben, 2020; see Wolfers & Utz, 2022, for a review). Drawing on both ER literature and UGT, Wolfers and Schneider (2021) suggest that digital technologies may be tools to improve stress-induced emotions. Indeed, quantitative (experience sampling) and qualitative (semistructured interview) research with adults has demonstrated that approximately half of their participants' smartphone use was related to ER, most often prompted by negative emotional states and stress (Shi et al., 2023). Moreover, in a thematic meta-synthesis, adolescents described using social media as a tool to regulate negative emotions (e.g., anger, sadness, boredom), as well as to promote positive emotions including excitement and happiness, and to "feel better" (Shankleman et al., 2021).

Adolescents do turn to digital technologies for ER. However, the efficacy of digital ER is difficult to determine within cross-sectional research or longitudinal research over months or even weeks. Instead, intensive repeated longitudinal designs, such as daily diary approaches, are useful for examining if digital ER relates to emotional experiences when reported within short windows of time. Nevertheless, this research has also produced mixed findings. In a study assessing young adults' negative emotions, digital and in-person support, and perceived ER success, Colasante et al. (2022) demonstrated comparable effectiveness of digital and in-person support for facilitating the downregulation of intense negative emotions for adolescents. In other research, engagement in supportive interactions via technology was associated with higher positive affect among college students (Oh et al., 2014). However, specific to ER, Shi et al. (2023) queried adults about their smartphone use to alter their emotional state and, although participants reported perceived change in their emotions from smartphone use, they found no association between the reported amount of time spent using smartphones for ER and change in affect that day (across hours). These findings suggest limited or transient effects of ER. However, no previous study that we could locate directly asked adolescents about their use of digital technologies specifically to regulate their emotions.

1.2 | Adolescents' prior symptoms of emotional problems as related to daily experience

Adolescents' individual differences, including symptoms of emotional problems, are thought to be particularly influential in shaping digital technology use and daily emotional experiences (Kross et al., 2020). For example, adolescents' depression and

anxiety symptoms are known to relate to experiencing more stress in daily life (Ha et al., 2019; Santiago et al., 2017; Uink et al., 2017), and more negative momentary or daily emotions (Ha et al., 2019; Uink et al., 2018). For example, adolescents who score higher on symptom measures report higher negative and less positive affect, and higher loneliness (but also happiness) across days (Uink et al., 2018). Likewise, adolescents who score higher in depression have a greater increase in negative affect and decrease in positive affect throughout the day, as well as more affective sensitivity to peer stress (Ha et al., 2019). Such findings suggest that symptoms of depression and anxiety might amplify emotions within and across days. Notably, symptoms could also amplify the use of digital devices in an attempt to regulate these more heightened emotions (e.g., seeking support or distraction; Modecki et al., 2021, 2023; Silk et al., 2003). We investigated these possibilities by comparing daily use of digital ER, emotions, and loneliness between adolescents with a high or a low level of prior emotional problems. As an adjunct, we also explored whether within-day associations, as well as cross-lagged associations between digital ER and emotions from one day to the next, differed for adolescents with a high or a low level of prior emotional problems.

1.3 | The current study

Adolescents use digital technologies for many reasons, including to relieve their negative emotions and to manage their social connection to make them happier or less lonely. Yet, we still know little about adolescents' use of digital ER and whether digital ER has the desired benefits of increasing happiness and decreasing negative emotions and loneliness. Without this information, it continues to be challenging to know how to help adolescents to make the most constructive use of technologies as a resource for coping and ER. We focus here on capturing adolescents' use of digital technologies specifically for ER, to investigate the links between daily digital ER use and adolescents' daily emotions, as well as recovery from peak negative emotions within a day. We also draw upon data collected before the diary measures to recruit and compare adolescents high or low in depressive and social anxiety symptoms. We addressed the following research questions:

> **RQ1.** Do adolescents report using digital technologies to regulate their emotions and loneliness, and if so, what are the associations between digital ER and same- and next-day reports of happiness, sadness, worry, anger, and loneliness?
>
> **RQ2.** Does digital ER use support adolescents' recovery from peak negative emotions (sadness, worry, anger) to the end of the same day?
>
> **RQ3.** What role do prior emotional problems play in adolescents' use of digital ER, and are the associations between digital ER and adolescents' same- and next-day emotions moderated by prior symptoms of emotional problems?

2 | METHOD

2.1 | Participants

The participants were 326 adolescents (M_{age} = 13.91, SD = 1.52; 44% boys) who were recruited from those who had participated in Time 1 (T1) of a longitudinal study (N = 863; see Zimmer-Gembeck et al., 2023 for more details). Data were collected from students of three Australian secondary schools (Grades 7–10) and five of their feeder primary schools (Grades 5 and 6). Across the schools, 52% of students had returned consent forms and, of these, 80% of parents gave informed consent. All participants with parent consent gave assent before participation. Most parents of adolescents in the longitudinal study (n = 677; 78%) agreed to be contacted for future research. From these, two symptom strata were formed based on adolescents' scores on depressive and social anxiety measures (see below). Adolescents were then randomly selected from these to achieve good representation of the two strata in this study. Parents and adolescents (326 of 465 contacted, 70%) who gave consent were introduced to the study protocol and chose a Monday to start the 7-day daily diary. Of the 326 diary participants, 14 adolescents completed less than 3 days and were excluded from this study, leaving a final sample of N = 312 adolescents. For recommendations regarding exclusions, see Brans et al. (2013) and Duvenage et al. (2020).

Adolescents could select multiple of the following to describe themselves: White; Asian; Australian First Peoples, Torres Strait Islander or Pacific Islander; other race/ethnicity; born in Australia; and born in New Zealand. Overall, 99% of adolescents ticked at least one answer, with 65% reporting White, 9% Asian, 5% Australian First Peoples, Torres Strait Islander or Pacific Islander, 37% other race/ethnicity, 85% born in Australia, and 7% born in New Zealand. The proportion of students in each school who spoke a language other than English at home ranged from 5%–29%. Individual income information was not collected, but schools reported 14%–29% of students were in the lowest, and 4%–30% in the highest, income quartiles.

2.2 | Procedure

Before data collection, approval was obtained from Griffith University (2019/178) Human Research Ethics Committee and the design was pre-registered on the Open Science Framework (see Zimmer-Gembeck et al., 2021). All participants had their own smartphone or tablet for use and were guided through installing an app on their device to capture their daily responses (Harris et al., 2019). Automatic text reminders were sent the evening before their selected start date, and daily reminders were sent at 6:00 p.m. (when the survey link opened) and 7:30 p.m. each evening for survey completion. Individual reminders were also sent at 8:30 p.m. if the survey remained incomplete, to ensure an appropriate level of recommended compliance (e.g., Duvenage et al., 2019). The opportunity for completing the diary closed at 11:00 p.m. each evening. After completion of the 7 days, each participant received a gift voucher ($5/day plus an extra $5 for completing all 7 days). For each completed day, participants were entered into one of three prize draws for another $100 gift voucher. Data recruitment and collection started in October 2021 with most data collected from March to May 2022, with a small group delayed in their participation until early August 2022. Data collection was suspended during the exam period of late November/early December, summer break (December–January), and first month of school (February).

2.3 | Prior symptoms of emotional problems

To measure symptoms of emotional problems before the diary completion, adolescents completed nine items as part of the T1 survey of the larger longitudinal study. Three items were drawn from the Children's Depression Inventory (CDI; Kovacs, 1985; e.g., I feel sad) and six items were drawn from the Social Anxiety Scale for Adolescents (SAS-A; La Greca & Lopez, 1998; e.g., I worry about doing something new in front of others). Item responses ranged from 1 (*No! Not at all true for me*) to 6 (*Yes! Totally true for me*), and all items were averaged (Cronbach's α = .91). A median split (2.00 for CDI and 3.00 for SAS-A) was used to identify strata. Adolescents in the high symptom strata (n = 128) had scores above the median on each measure (M_{CDI} = 3.74, M_{SAS-A} = 4.53). Adolescents in the low symptom strata (n = 184) had scores below the median for both (62%) or had one score below and one above the median (38%; M_{CDI} = 1.52, M_{SAS-A} = 2.27).

2.4 | Daily diary measures

2.4.1 | End of day emotions

Adolescents reported their happiness, sadness, worry, anger, and loneliness ("How happy/sad/worried/angry/lonely are you feeling right now?") at the end of each day from 1 (*Not at all*) to 7 (*Extremely*).

2.4.2 | Peak negative emotions

Following an open-ended question to describe the worst stressor of their day, adolescents reported the intensity of their sadness, worry, and anger (three questions) that day ("At its WORST today, how sad or down/worried or uneasy/angry or irritated did you feel about this problem?") from 1 (*Not at all*) to 7 (*Extremely*; see Silk et al., 2003).

2.4.3 | Emotional recovery

Similar to past research (Ha et al., 2019), adolescents' end-of-day emotion and peak daily negative emotion (described above) were used to calculate daily emotion recovery. For example, for sadness, daily emotion recovery each day was calculated as the difference between the reported peak sadness on the day and end-of-day sadness on that same day (i.e., peak daily sadness—end-of-day sadness). Daily emotion recovery for worry and anger were also calculated.

2.4.4 | Digital technology use for emotion regulation (digital ER)

At the end of each day, adolescents reported their use of digital technologies to regulate emotion with one item drawn from van Ingen, Utz, and Toepoel (2016) and adapted for a daily diary format ("How much did you use technology [e.g., social media, texting, gaming, or browsing the internet] today to try to make yourself feel better or help with your emotions?"). Responses ranged from 1 (*Not at all*) to 7 (*Extremely*).

2.5 | Overview of the data analyses

Before addressing the aims of the study, data were examined for possible data quality problems and 13 single day entries were removed. In total, 1995 daily diary entries of 2184 possible (91%) from 312 adolescents were available for within-day analyses, and 1676 daily entries of 1872 possible (90%) for analyses involving associations across days (i.e., first day reports could not be included as outcome variables).

After reporting descriptive statistics and correlations between measures (averaged across all days), Mplus v8.8 (Muthén & Muthén, 2017) was used to fit multilevel path models of daily ER as associated with the four emotions and loneliness from one day to the next. Using restricted maximum likelihood estimation, models were fit to estimate associations of digital ER use at time T-1 (i.e., where T indicates the day of measurement and T-1 indicates the day before) with change in the five emotions from time T-1 to time T (the day before to the current day) and the reverse—the associations of each of the five emotions at time T-1 with change in digital ER use from time T-1 to time T. In these models, autoregressive paths between consecutive days of digital ER and the emotions were also estimated, as were the within-day associations between measures. Sensitivity analyses were also conducted to analyze digital ER as related to each emotion (or loneliness)—analyzed one at a time—and in separate models specifying adolescent age at Level 2 as a covariate of digital ER and emotion or loneliness.

We next conducted analyses to focus on the effect of digital ER use on emotion recovery on the same day. To do this, we fit a multilevel path model to estimate the associations of digital ER use at time T with emotion recovery (for sadness, worry, and anger) at time T. In this model, we also controlled for peak emotion that day, given that higher peak negative emotion could be related to recovery that day.

Finally, we conducted analyses of prior symptom status. We compared the daily emotions and digital ER of the high and low symptom groups using t-tests after averaging reports across the 7 diary days. Furthermore, to investigate whether adolescents' symptom status conditioned associations of digital ER use with change in emotions from day to day, we tested cross-level interactions (between-subject Level 2 × within-subject Level 1) including estimation of random intercepts and slopes. Multiple models were fit, testing one interaction at a time.

3 | RESULTS

3.1 | Descriptive statistics and correlations

Table 1 presents means and standard deviations and Pearson's correlations between all daily measures (averaged across all days). Average 7-day level of digital ER was negatively associated with average 7-day happiness and positively associated with average 7-day negative emotions and loneliness.

3.2 | Within-person bidirectional associations of digital ER with emotions across days

Variance component (i.e., null) models for daily measures revealed intraclass correlations between .29 and .48, indicating that between 29% and 48% of the variance in adolescents' digital ER use, emotions, and loneliness could be explained by differences between participants, whereas the remaining variance (52%–71%) was within adolescents over the days.

TABLE 1 Descriptive statistics and Pearson correlations between daily emotions and digital ER (number of observations = 1995).

	1	2	3	4	5	6	7	8	Mean (SD)
1. Happy	–								4.66 (1.62)
2. Sad	−.50**	–							2.11 (1.48)
3. Worried	−.33**	.60**	–						2.10 (1.48)
4. Angry	−.38**	.60**	.48**	–					1.93 (1.45)
5. Lonely	−.34**	.57**	.50**	.46**	–				2.13 (1.64)
6. Peak sad	−.29**	.48**	.41**	.35**	.40**	–			2.87 (1.89)
7. Peak worried	−.22**	.38**	.48**	.28**	.35**	.66**	–		2.96 (1.91)
8. Peak angry	−.25**	.36**	.30**	.42**	.30**	.59**	.50**	–	2.95 (1.94)
9. Digital ER	−.06*	.14**	.16**	.10**	.21**	.24**	.25**	.22**	3.49 (2.13)

Abbreviation: ER, emotion regulation.

*p < .01; **p < .001.

TABLE 2 Results of the multilevel bidirectional autoregressive path model of digital ER use and emotion across days.

Paths	B	SE (B)	p	β
Bidirectional (Day T-1 → Day T)				
Digital ER use → Happy	0.00	0.02	.832	.00
Digital ER use → Sad*	0.06	0.02	<.001	.10
Digital ER use → Worried*	0.05	0.02	.005	.07
Digital ER use → Angry*	0.03	0.02	.048	.05
Digital ER use → Lonely*	0.05	0.02	.008	.07
Happy → Digital ER use	0.01	0.03	.889	.00
Sad → Digital ER use	0.05	0.05	.358	.03
Worried → Digital ER use	−0.06	0.04	.171	−.04
Angry → Digital ER use	−0.06	0.04	.162	−.04
Lonely → Digital ER use*	0.11	0.03	.003	.08
Concurrent associations (within day T)				
Digital ER with happy*	−0.13	0.07	.068	−.05
Digital ER with sad	0.10	0.07	.106	.04
Digital ER with worried*	0.18	0.06	.002	.08
Digital ER with angry	0.09	0.06	.150	.04
Digital ER with lonely*	0.24	0.06	<.001	.10
Happy with sad*	−0.95	0.05	<.001	−.48
Happy with worried*	−0.53	0.06	<.001	−.27
Happy with angry*	−0.72	0.05	<.001	−.36
Happy with lonely*	−0.63	0.06	<.001	−.32
Sad with worried*	0.89	0.05	<.001	.51
Sad with angry*	1.02	0.05	<.001	.56
Sad with lonely*	0.81	0.05	<.001	.45
Worried with angry*	0.79	0.05	<.001	.44
Worried with lonely*	0.61	0.05	<.001	.35
Angry with lonely*	0.67	0.05	<.001	.36
Autoregressive paths (Day T-1 → T)				
Digital ER*	0.55	0.02	<.001	.55
Happy*	0.43	0.02	<.001	.42
Sad*	0.35	0.02	<.001	.33
Worried*	0.34	0.02	<.001	.36
Angry*	0.23	0.02	<.001	.23
Lonely*	0.43	0.02	<.001	.46

Note: Results were similar when one emotion or loneliness was considered in a model separate from the others (e.g., a model testing bidirectional associations of digital ER and happiness from one day to the next only). Model fit: $\chi^2(20) = 266.56$, $p < .001$, CFI = 0.95.

Abbreviations: CFI, Comparative fit index; ER, emotional regulation.

*Significant association. Happy $R^2 = .18$, Sad $R^2 = .12$, Worried $R^2 = .14$, Angry $R^2 = .06$, Lonely $R^2 = .23$, Digital ER $R^2 = .32$.

As shown in Table 2, adolescents' use of digital ER was associated with a greater increase in sadness ($\beta = .10$, $p < .001$), worry ($\beta = .07$, $p = .005$), anger ($\beta = .05$, $p = .048$), and loneliness ($\beta = .07$, $p = .008$) from 1 day to the following day, but not happiness. Further, loneliness was associated with an increase in digital ER from 1 day to the following day ($\beta = .08$, $p = .003$). In addition, as can also be seen in Table 2, digital ER was associated with less happiness and more worry and loneliness on the same day, all emotions and loneliness were intercorrelated within days, and there were moderate to high stabilities for all measures on consecutive days, with the highest stability found for digital ER ($\beta = .55$). It is noteworthy that we repeated these analyses considering one emotion or loneliness at a time (five separate multilevel bidirectional path models) with little change to the results. Finally, we examined the effect of adolescent age (at Level 2) on the findings. Although participant age was positively associated with more worry ($B = 0.36$, $p < .001$), sadness ($B = 0.22$, $p = .004$), and loneliness ($B = 0.14$, $p = .021$), all significant associations in Table 2 remained significant after adjusting for age.

3.3 | Within-person and within-day associations of digital ER with emotion recovery

To determine whether digital ER was associated with emotion recovery (a greater decline from the peak of emotion on that day to the end-of-day), we fit a multilevel model to estimate associations of digital ER with recovery. In this model, we anticipated that a higher level of negative emotion may be related with the opportunity for recovery, so we included peak sadness, worry, and anger as control variables. As shown in Table 3, digital ER was associated with better recovery from sadness ($\beta = .04$, $p = .002$) and worry ($\beta = .05$, $p < .001$) by the end-of-day. Moreover, in this same model, adolescents who reported a higher peak level of sadness, worry, or anger showed less recovery by the end of the day.

3.4 | Between-person symptom status

The second aim of this study was to consider whether adolescents' prior emotional symptom status (high/low symptoms) was associated with daily level of digital ER use and emotions or loneliness, and to test if symptom level moderated any associations. As shown in Table 4, t-tests showed that all measures differed between the two groups; adolescents classified as

TABLE 3 Associations of digital ER with emotional recovery (peak to end-of-day emotion), controlling for same-day peak emotion level.

Paths	B	SE (B)	p	β
Associations of digital ER with recovery				
Digital ER use → Sad recovery*	0.04	0.01	.002	.04
Digital ER use → Worried recovery*	0.05	0.01	<.001	.05
Digital ER use → Angry recovery	0.01	0.01	.218	.02
Associations of peak emotion with recovery				
Peak sadness → Sad recovery*	−0.71	0.01	<.001	−.72
Peak worry → Worried recovery*	−0.70	0.01	<.001	−.72
Peak anger → Anger recovery*	−0.74	0.01	<.001	−.74
Associations between emotions				
Peak sadness with peak worry*	2.38	0.10	<.001	.66
Peak sadness with peak anger*	2.17	0.11	<.001	.60
Peak worry with peak anger*	1.84	0.10	<.001	.50
Associations between recovery				
Sad recovery with worry recovery*	0.85	0.04	<.001	.50
Sad recovery with angry recovery*	0.90	0.04	<.001	.52
Worry recovery with angry recovery*	0.71	0.04	<.001	.42

Note: Results were similar when one emotion was considered in a model separate from the others (e.g., a model of only digital ER, sad recovery, and peak sadness).

Abbreviations: CFI, comparative fit index; ER, emotional regulation. Model fit: $\chi^2(9) = 288.53$, $p < .001$, CFI = 0.96.

*Significant association. Sad recovery $R^2 = .52$, Worry recovery $R^2 = .51$, Angry recovery $R^2 = .55$.

TABLE 4 Descriptive statistics and independent samples *t*-test results across prior emotional symptom status (high/low symptoms) for emotions and digital ER averaged across all days.

	Low symptoms (*n* = 184)		High symptoms (*n* = 128)		Independent *t*-tests and effect sizes	
	Mean	SD	Mean	SD	*t*	Cohen's *d*
Happiness	4.90	1.55	4.29	1.66	8.34*	.38
Sadness	1.85	1.26	2.51	1.67	−9.37*	.45
Worry	1.86	1.27	2.47	1.67	−8.87*	.41
Anger	1.76	1.31	2.19	1.59	−6.35*	.30
Loneliness	1.86	1.43	2.54	1.84	−8.86*	.41
Digital ER use	3.31	2.13	3.76	2.11	−4.63*	.21

Abbreviation: ER, emotional regulation.

*All *p* < .001.

high in prior emotional symptoms, relative to those with low symptoms, were lower in happiness and higher in negative emotions, loneliness, and digital ER, with moderate to large effect sizes.

To test symptom status as a moderator, we fit multilevel path models adding cross-level interactions of Level 1 measures (daily digital ER use or emotions/loneliness) with symptom status (high/low) at Level 2. First, we fit five models to test whether symptom status was a moderator of within-day (i.e., concurrent) associations of digital ER use with each emotion or loneliness. Second, we fit another five models considering symptom status as a moderator of associations between digital ER and change in emotions or loneliness (and the converse) from one day to the next. Adolescents classified as high in prior emotional symptoms were significantly less happy (cross-level interaction *B* = −0.66) and significantly more sad, worried, angry, and lonely (cross-level interaction *B*'s ranged from 0.46 to 0.59) on any given day than low symptom adolescents, but symptom status was not a significant moderator of any association between digital ER and emotions/loneliness.

4 | DISCUSSION

In the current study, we investigated whether adolescents' daily reports of their use of digital ER did indeed contribute to their experience of positive and negative emotions or loneliness by the evening of the same day and by the next evening. Further, we examined these associations in adolescents high or low in emotional problems. There were four key findings that together suggest that adolescents do report interacting with digital technology for ER, but that it has mixed associations with emotions and loneliness across days for adolescents, and these associations do not significantly differ based on prior level of emotional problems.

The first finding, based on the average digital ER use across the days, was that adolescents report a moderate level of digital ER but that varies greatly across adolescents. Also, when adolescents' emotions are all entered into a single multilevel model, adolescents are more worried and lonelier on days when they report more digital ER. These findings, albeit with small effects, add to previous findings linking coping, including by using digital technologies, to more distress in adolescents (Uink et al., 2017, 2018) and adults (Shi et al., 2023).

Second, digital ER use is related to adolescents' short-term recovery (i.e., downregulation) from their peak of sadness and worry within the same day, but it is also associated with what appears to be a rebound of negative emotion—worse negative emotion and more loneliness by the next evening. Although the effect sizes were small, these results are consistent with emerging findings of some emotional relief from interacting with digital technologies for ER, but indicate that the benefits may be short-term, providing only transitory relief from distress (Dolev-Cohen & Barak, 2013; Lo, 2019). It is possible that digital ER has an immediate downregulatory effect via its role in providing distraction, positive interactions, or a place to seek support and assistance (Lo, 2019; Rideout et al., 2021; Stockdale & Coyne, 2020; Wolfers & Schneider, 2021), but such benefits may dissipate and adolescents return to a persistent or escalating state of negative emotion. Taken together, these results suggest that adolescents may perceive their use of digital technologies as tools for ER and to cope with stress (Rideout et al., 2021; Shankleman et al., 2021) because of some immediate benefits. However, based on these results and those of others (Brimmel et al., 2023; Kross et al., 2013; van Ingen, Utz, & Toepoel, 2016), adolescents might need education and support to use digital ER constructively as one of many possible ways to respond when they need an uplift or are searching for ways to manage distress or alleviate loneliness in the short and long term.

Third, the reverse paths from emotions to next day digital ER were less frequently significant, with loneliness standing out as the one correlate of an increase in digital ER by the next evening. This finding highlights the salience of loneliness as a precursor to more digital ER use, corroborating past research in which adults with greater loneliness were more likely to

report using online strategies to supplement offline strategies than their less-lonely counterparts (van Ingen & Wright, 2016). Given that adolescents who are lonelier are more likely turning to digital ER, it would be useful for future research to identify specific ways that using digital technologies can result in sustained reductions in loneliness. Increasingly, evidence is suggesting that digital technologies must be used to enhance existing relationships or to develop new (and meaningful) social connections that endure to reduce loneliness (Deters & Mehl, 2012; Nowland et al., 2018; Wenninger et al., 2019). In this study, we did not assess the specific strategies adolescents used for digital ER, and it is not known whether specific emotions or loneliness were linked to different digital ER strategies. We recommend that future research explores a broader range of digital ER strategies among adolescents to consider their relations to within and across day emotions, especially given that some ER strategies are of greater benefit to modulating some emotions more than others (Shu et al., 2021). For instance, Eschler et al. (2020) found that adults report strategies including streaming content, online gaming, and engaging with online support groups to feel calm or to prevent negative moods. These digital ER strategies serve different functions and could have different implications for emotion dynamics or be influenced by different emotion profiles. Other research points to digital technology use for information seeking (Barahmand et al., 2019; Stockdale & Coyne, 2020), which can relieve some stressors and distress.

Fourth, we compared adolescents who were classified as high in emotional problems to those low in problems drawing on available prior data that measured depressive and social anxiety symptoms. As would be expected (Ha et al., 2019; Uink et al., 2018) and validating the two symptom strata, emotions across the daily diary were more negative for adolescents classified as high relative to low in symptoms, with large effect sizes. In addition, adolescents high in prior emotional problems reported a higher frequency of digital ER use on average than other adolescents. Yet, our tests of whether symptom status moderated associations of digital ER with emotions (within and across days) revealed that adolescents high in prior symptoms were not more or less susceptible to increasing negative emotions and loneliness in relation to digital ER use, relative to other adolescents. Thus, the core findings generalized to both symptom strata in this study, and the association of digital ER with emotions was quite varied within all adolescents included in this study.

These findings of symptom strata differences but no moderation effects raise multiple future research directions. As one example, this study should be extended to consider what adolescents are doing online in their attempts to feel better. Specific strategies for ER could differ by symptom type (e.g., depression vs. anxiety) and could reveal different associations within symptom strata. We suggest it would be especially important to differentiate strategies for distraction to feel better from strategies with other functions related to regulating emotion (e.g., support, information seeking). Considering these uniquely and in combination might reveal clusters of strategies that differ between symptom strata and relate differently to emotions within and across days. For example, distraction can regulate high intensity negative emotion especially in the short-term, but other coping strategies such as problem-solving, help-seeking from informed sources, and cognitive reappraisal, may be helpful for lower intensity distress or when emotions are not at their peak (Masters et al., 2023; Van Bockstaele et al., 2020; Zimmer-Gembeck et al., 2013). Adolescents who tend towards high levels of emotional problems may be better off if they use distraction to downregulate emotion so they can effectively utilize other coping strategies, whereas adolescents lower in symptoms may get benefits from other ER strategies with or without distraction. Furthermore, considering combinations of ER or coping strategies might also be useful for identifying if digital ER is used as a replacement for other strategies (such as problem solving; see Brimmel et al., 2023). Thus, it may not be digital ER that differently relates to emotion by symptom strata, but it may be what else adolescents do (or do not do) that matters (e.g., allocation of strategies for ER or coping; Skinner et al., 2013).

As a second example for future research, there is evidence that the reasons for digital technology use may vary depending on stress level (Stockdale & Coyne, 2020). Future research should incorporate information about stressors to attend to potential differences in the personal and interpersonal circumstances of adolescents who are, compared with those who are not, reporting elevated depression and social anxiety. This would allow for some consideration of how stressors and digital ER uniquely and interactively relate to emotion and recovery within and across days.

4.1 | Study limitations, future research, and implications

In addition to the ideas for future research mentioned above, there are four additional limitations that yield other future research ideas. First, we did not measure digital stress (Freytag et al., 2021) or level of use of digital media in general. These are two potentially relevant covariates of emotions and loneliness to consider alongside digital ER use in future research. Second, we collected data one time per day, at the end of the day. Thus, daily accounts of peak sadness, worry, and anger were retrospectively reported at the end of the day. This meant that we could not control for the varying time between peak emotion to end-of-day emotion across adolescents. Third, although we relied on single-item items to measure adolescents' emotions, loneliness, and digital ER—a common approach in experience sampling and daily diary methods to limit participant burden (Modecki et al., 2023)—we note that continuing to refine measures and approaches will be important in the future. Fourth, despite a relatively large sample size, high participation and retention, and random selection from two

strata of adolescents from a larger possible pool, the group sizes could have limited our power to detect small cross-level interactions. In addition, we did not determine symptom strata based on objective cutoffs. Instead, we used median scores to determine high or low symptoms, so strata are relative to the adolescents included in our larger longitudinal study (Zimmer-Gembeck et al., 2023).

The data collection strategy used here could be useful for clinicians, especially if information on other ER strategies and stressors are also collected. Asking youth to monitor their experience of daily emotions along with daily digital ER and other ER attempts over a period of just one week could give clinicians valuable insights to feed back to young people about the effectiveness of their ER in general. As such, clinicians and young people could use this monitoring data to develop digital media goals that optimize ER with the aim of upregulating positive and downregulating negative emotion during everyday life.

5 | CONCLUSION

We found that digital ER use was related to adolescents' recovery from sadness and worry at the peak to the end-of-day, but it was also associated with more negative emotions and loneliness by the next day among all adolescents, regardless of reporting a prior high or low level of emotional problems. Thus, adolescents may experience some short-term emotional recovery from digital ER, but this may not follow through into the next day, and it can even result in an increase in sadness, worry, anger, and loneliness. In addition, lonelier adolescents were found to increase in digital technology use for ER by the next day, suggesting there is a case for concentrating efforts on supporting lonely adolescents to navigate digital technologies (and offline resources) to better address their needs for social connection.

AUTHOR CONTRIBUTIONS
Riley A. Scott developed the study, performed data analyses, interpreted findings, and co-produced the paper. Melanie J. Zimmer-Gembeck developed the study, performed data analyses, interpreted findings, and co-produced the paper. Alex A. Gardner co-produced the paper. All authors contributed to study design. Data collection was led by Alex A. Gardner and Tanya Hawes. Other authors provided critical revisions. All authors approved the final version of the manuscript for submission.

CONFLICT OF INTEREST STATEMENT
The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT
The data are available from the corresponding author upon reasonable request.

ETHICS STATEMENT
The study was approved by Griffith University Human Research Ethics Committee (GU Ref No: 2019/178). The study was carried out in accordance with the World Medical Association Declaration of Helsinki.

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