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Notification Fatigue, Attentional Control, and Psychological Well-Being among Young Adult Smartphone Users in Pakistan: A Cross-Sectional Correlational Study

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ABSTRACT

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Smartphone notifications are a primary mechanism through which digital communication reaches users, and each alert constitutes a small demand on attention. Research in this area has largely treated notification exposure as a matter of frequency, leaving the subjective experience of notification burden comparatively unexamined, particularly in South Asian populations. The present study examined the relationships among notification fatigue, attentional control, and psychological well-being among young adult smartphone users in Pakistan. A quantitative, cross-sectional correlational design was employed. Three hundred and fifty smartphone users aged 18 to 25 years were recruited through non-probability purposive and convenience sampling. Notification fatigue was assessed using a five-item measure adapted to the smartphone-notification context from the social networking service fatigue measure of Lee et al. (2016), attentional control using the Attentional Control Scale (Derryberry & Reed, 2002), and psychological well-being using the Psychological Wellbeing Scale for Muslim Societies (Akhtar et al., 2023). Data were analysed using descriptive statistics, reliability analysis, and Pearson product-moment correlation. Notification fatigue was negatively associated with both attentional control and psychological well-being, while attentional control was positively associated with psychological well-being. All three alternative hypotheses were supported. The two notification-related associations were small in magnitude, and the association between attentional control and psychological well-being approached a moderate magnitude. These findings provide preliminary evidence that appraised notification burden is associated with poorer self-reported attentional control and with lower positive psychological functioning. Because the notification fatigue measure is an adaptation without independent validation, the results should be read as provisional, and the correlational design precludes any causal interpretation.

Introduction

Smartphone notifications are a primary mechanism through which digital communication reaches users. Visual banners, auditory alerts, and haptic signals arrive continuously across messaging applications, social platforms, academic portals, and commercial services, and each one constitutes a small demand on the recipient's attention. Experimental work has established that this demand is not trivial. Stothart et al. (2015) demonstrated that receiving a notification alone significantly degraded performance on a sustained attention task, even when participants never interacted with the device; the disruption occurred at the point of the alert rather than at the point of use. Upshaw et al. (2022) extended this finding using behavioural and electrophysiological indices, reporting that participants responded more slowly on trials paired with smartphone notification sounds than on control trials, and showed a larger N2 event-related potential on those trials, indicating that greater cognitive control was recruited when a notification sound was present. These studies place the notification, rather than smartphone use as such, at the centre of the cognitive account.

A parallel body of field research has examined what happens when the flow of notifications is altered. Kushlev et al. (2016) manipulated notification settings across one-week periods and found that participants reported higher inattention and hyperactivity symptoms during the week in which alerts were enabled, with inattention in turn predicting lower productivity and psychological well-being. Fitz et al. (2019) conducted a randomised field experiment with a purpose-built application and found that delivering notifications in three predictable daily batches reduced stress and increased well-being, whereas hourly batching produced little change relative to usual use and switching alerts off entirely produced greater anxiety and fear of missing out. Taken together, these results resist a simple dose-response reading. More notifications are not uniformly worse and fewer are not uniformly better; what appears to matter is the predictability and manageability of the flow, and the psychological meaning the user assigns to it.

This is the point at which notification fatigue becomes conceptually necessary, and the construct has a specifiable theoretical lineage. Lee et al. (2016) examined SNS fatigue within the transactional model of stress (Lazarus & Folkman, 1984), treating information overload, communication overload, and system feature overload as stressors and fatigue as the resulting strain. On that account, fatigue is not a direct function of message volume but of the appraised mismatch between the demands the technology generates and the resources the user has available to meet them. Applied to notifications, the framework predicts precisely the non-linear pattern that Fitz et al. (2019) observed: batching reduces the appraised unpredictability of the demand without removing the informational benefit, whereas complete disabling removes the demand at the cost of introducing a different stressor, namely uncertainty about what is being missed. Notification fatigue, understood this way, refers to the subjectively experienced tiredness and depletion that accumulates from appraised notification demand – a state distinct both from objective alert volume and from problematic or addictive smartphone use. The definition is deliberately confined to depletion rather than extended to irritation or disengagement, because the item content available for adaptation addresses difficulty relaxing after use, post-use fatigue and exhaustion, and impaired concentration on subsequent tasks; it does not sample irritation or behavioural withdrawal. A broader definition would exceed what the present measure can support. Within a limited-capacity account of attention (Kahneman, 1973), each interruption draws on a finite resource pool; the cumulative appraisal of that draw is plausibly what the individual experiences as fatigue. The chain assumed here runs from notification exposure, through the appraisal of that exposure as exceeding available resources, to the resulting strain. Notification fatigue is positioned at the third point in that sequence, as strain rather than as stressor or appraisal. This differs from the parent framework, in which notification volume sits among the stressors and fatigue is the general outcome of several overload types, and the distinction is stated here because the present study measures only the strain term and cannot separate it from the appraisal that precedes it.

Attentional control is the second variable of interest. Derryberry and Reed (2002) conceptualised attentional control as a temperamentally grounded individual difference in the voluntary regulation of attention, encompassing the capacity to sustain focus in the presence of competing stimuli and to shift attention flexibly between tasks. Attentional control theory (Eysenck et al., 2007) situates this capacity within the interplay between goal-directed and stimulus-driven attentional systems, holding that impairments in attentional control manifest primarily in processing efficiency rather than in performance effectiveness. Smartphone notifications are close to a prototype of the stimulus-driven interruption this framework describes: they are salient, socially weighted, and unpredictable in timing. Individuals who report weaker attentional control may therefore be expected to find persistent alerts more burdensome, though the direction of any such association cannot be determined from correlational evidence alone. It is equally plausible that sustained notification burden erodes self-perceived attentional capacity, or that a third variable such as trait anxiety underlies both.

The third variable, psychological well-being, is drawn deliberately from the eudaimonic rather than the hedonic tradition. Ryff (1989) argued that well-being should not be reduced to the absence of symptoms or the presence of positive affect, and specified six dimensions of positive functioning: self-acceptance, positive relations with others, autonomy, environmental mastery,

purpose in life, and personal growth. This multidimensional structure was subsequently supported and refined by Ryff and Keyes (1995). Framing the outcome in these terms represents a departure from the dominant pattern in smartphone research, which has concentrated heavily on problematic use, addiction, anxiety, and depression. If notification experiences are relevant to how young adults function well – not merely to whether they are distressed – that relevance should be visible against a positive-functioning criterion.

Measuring psychological well-being in Pakistan raises a specific psychometric issue. Akhtar et al. (2023) administered the 18-item short form of the Ryff Scales of Psychological Wellbeing to 370 young adults aged 18 to 26 years who were born and resident in Punjab, and tested whether negatively voiced items detracted from the unidimensionality of the scale. Both of their hypotheses were supported: the negatively voiced items performed poorly, and the remaining 10 positively voiced items generated a unidimensional and reliable measure covering all six of Ryff's proposed components. The resulting Psychological Wellbeing Scale for Muslim Societies (PWS-MS) provides a locally validated instrument developed on precisely the population of interest here, and its use avoids the common practice of importing an unadapted Western measure into a Pakistani sample.

Despite the volume of research on smartphone use, attention, and mental health, three gaps remain. First, the fatigue construct has been developed almost entirely with reference to social networking services rather than to notifications as such, and notification-specific measurement is correspondingly underdeveloped. Second, cognitive functioning and positive psychological functioning are rarely examined together in the same notification-focused study, which leaves the cognitive and eudaimonic literatures largely parallel rather than integrated. Third, most of this literature has been produced in East Asian, North American, and European samples, and research specifically examining notification fatigue among Pakistani young adults appears limited. No systematic search was conducted, so this is offered as an observation about the accessible literature rather than as a claim of priority.

The present study therefore examined the relationships among notification fatigue, attentional control, and psychological well-being among smartphone users aged 18 to 25 years in Pakistan. Consistent with a correlational design, the study estimated the strength and direction of association among these variables and makes no causal claim.

Objectives

1. To assess levels of notification fatigue, attentional control, and psychological well-being among young adult smartphone users aged 18 to 25 years.
2. To examine the relationship between notification fatigue and attentional control.
3. To examine the relationship between notification fatigue and psychological well-being.
4. To examine the relationship between attentional control and psychological well-being.

Hypotheses

H1: There is a significant relationship between notification fatigue and attentional control among young adult smartphone users.

H2: There is a significant relationship between notification fatigue and psychological well-being among young adult smartphone users.

H3: There is a significant relationship between attentional control and psychological well-being among young adult smartphone users.

The corresponding null hypotheses (H_{01} , H_{02} , H_{03}) stated that no significant relationship exists in each case.

Method

Research Design

A quantitative, cross-sectional correlational design was used. All variables were measured at a single time point through self-report, and no variable was manipulated. The design supports estimation of the magnitude and direction of bivariate association but does not permit causal or temporal inference.

Participants

The sample comprised 350 young adult smartphone users in Pakistan aged 18 to 25 years ($M = 21.47$, $SD = 2.18$), recruited through non-probability purposive and convenience sampling. Females constituted 59.4% of the sample and males 40.6%.

Most participants were students (65.1%) and enrolled at the undergraduate level (56.6%). Full demographic and smartphone-use characteristics are reported in Tables 2 and 3.

Participants were eligible if they were aged between 18 and 25 years, used a smartphone regularly on a daily basis, were able to read English or Urdu sufficiently to complete the questionnaire, provided informed consent, and participated voluntarily. Individuals who were unable to complete the questionnaire independently, or who did not use a smartphone regularly, were excluded.

Measures

Notification Fatigue

Notification fatigue was assessed using a five-item self-report measure of subjectively experienced fatigue attributable specifically to smartphone notifications. The items derive from the five-item SNS fatigue measure of Lee et al. (2016), which operationalised fatigue as the strain component of a transactional stress process in which information overload, communication overload, and system feature overload act as stressors. Lee et al. did not generate their items de novo: they adapted established occupational strain items from Karasek (1979) and Van Yperen and Hagedoorn (2003) to the social networking context, retaining content concerning difficulty relaxing after use, post-use fatigue and exhaustion, and impaired concentration on subsequent tasks. In their Korean sample of 201 respondents the five-item measure performed well, with Cronbach's alpha of .90, composite reliability of .93, average variance extracted of .72, and standardised loadings between .80 and .90, and it was administered on a seven-point Likert scale.

For the present study the item referent was changed from social networking services to smartphone notifications, retaining the original strain content and the seven-point response format. No published notification-referenced adaptation of these items was identified, so the adaptation reported here was carried out by the present authors. Items were scored as an item mean, with higher scores indicating greater notification fatigue. Internal consistency in the present sample was acceptable ($\alpha = .82$). The instrument lineage is therefore traceable from occupational strain measurement, through the SNS-referenced form reported by Lee et al., to the notification-referenced form used here. The notification-referenced form should be regarded as an adapted, preliminary measure: no factor-analytic or validity evidence exists for it, and this is addressed in the Limitations.

It is worth noting that notification content already appears on the stressor side of the parent instrument: one of Lee et al.'s communication overload items refers explicitly to receiving too many notifications of new postings, push messages, and news feeds while performing other tasks. The present study relocates that content from the stressor side to the strain side, which is a substantive conceptual move rather than a purely lexical one.

The measure was administered in English, as no validated Urdu adaptation was available; English reading proficiency was therefore screened during recruitment.

Attentional Control

Attentional control was assessed using the 20-item Attentional Control Scale (ACS; Derryberry & Reed, 2002), a self-report measure of the voluntary capacity to focus attention and to shift attention between tasks. Higher total scores indicate greater self-reported attentional control. Internal consistency in the present sample was acceptable ($\alpha = .79$). A unidimensional total score was used. Subsequent psychometric work has supported a reduced two-factor structure comprising focusing and shifting subscales rather than a single dimension (DeVito et al., 2019); this was not modelled in the present study and is addressed in the Limitations.

Psychological Well-Being

Psychological well-being was assessed using the 10-item Psychological Wellbeing Scale for Muslim Societies (PWS-MS; Akhtar et al., 2023). The PWS-MS was derived from the 18-item short form of the Ryff Scales of Psychological Wellbeing through the removal of the eight negatively voiced items, which were found to detract from unidimensionality in a Pakistani young-adult sample; the retained 10 positively voiced items represent all six of Ryff's components. Akhtar et al. reported good internal consistency ($\alpha = .88$) in a sample of 370 young adults aged 18 to 26 years from Punjab. Internal consistency in the present sample was good ($\alpha = .86$). Higher scores indicate greater psychological well-being. Consistent with the unidimensional structure reported by the scale developers, only the total score was used; no subscale scores were computed. Items are rated on a seven-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*), giving a possible total range of 10 to 70; the observed maximum of 59 in the present sample therefore indicates no ceiling effect.

Procedure

The questionnaire was administered online. The instrument comprised an informed-consent section, a demographic section, a smartphone-use section, and the three study measures. Participants were informed of the study aims, the voluntary nature of participation, the absence of identifying information, and their right to withdraw at any point without penalty. No incentive was offered. Responses were collected anonymously and stored securely.

Ethical Considerations

All ethical protocols governing research with human participants were followed throughout the study. Written informed consent was obtained from all participants before data collection. Participants were informed about the purpose and nature of the study, the voluntary nature of participation, and their right to withdraw at any stage without penalty or providing a reason. No names, initials, or other directly identifying information were collected. Responses were treated as confidential, stored securely, and used solely for academic research purposes. All participants were adults aged 18 years or above, and no incentive or inducement was offered for participation.

Data Analysis

Data were analysed using IBM SPSS Statistics. Screening for duplicate cases, missing data, and out-of-range values preceded analysis. Missing item-level responses were omitted from the analyses to which they contributed, and all 350 cases were retained. Descriptive statistics (mean, standard deviation, observed minimum and maximum, skewness, and kurtosis) were computed for each study variable, and internal consistency was evaluated using Cronbach's alpha. The three hypotheses were tested using Pearson product-moment correlation with two-tailed significance testing at $\alpha = .05$. Ninety-five percent confidence intervals for each correlation were derived using Fisher's r -to- z transformation, and the proportion of shared variance was reported as r^2 . Effect sizes were interpreted using Cohen's (1988) conventions.

Results

Data Screening and Preparation

A total of 350 responses were obtained and screened prior to analysis. No duplicate cases and no out-of-range values were identified. Overall item-level missingness was below 1%, and no participant had substantial missing data. All 350 cases were retained for the final analysis (Table 1).

Table 1

Data Screening and Preparation

Screening criterion	Result
Responses received	350
Duplicate cases	0
Cases with substantial missing data	0
Out-of-range values	0
Overall item-level missingness	<1%
Final analytic sample	350

Demographic Characteristics

The final sample consisted of 350 young adults aged 18 to 25 years ($M = 21.47$, $SD = 2.18$). Demographic characteristics are presented in Table 2.

Table 2**Demographic Characteristics of Participants (N = 350)**

Characteristic	Category	<i>n</i>	%
Gender	Male	142	40.6
	Female	208	59.4
Age	18–20 years	111	31.7
	21–23 years	154	44.0
	24–25 years	85	24.3
Education	Undergraduate	198	56.6
	Graduate	117	33.4
	Other	35	10.0
Occupation	Student	228	65.1
	Employed	86	24.6
	Other	36	10.3

Smartphone-Use Characteristics

Roughly seven in ten participants (70.6%) reported using a smartphone for between three and eight hours daily, and social media and messaging together accounted for the primary activity of 71.7% of the sample (Table 3).

Table 3**Smartphone-Use Characteristics of Participants (N = 350)**

Characteristic	Category	<i>n</i>	%
Daily smartphone use	<3 hours	48	13.7
	3–5 hours	126	36.0
	6–8 hours	121	34.6
	>8 hours	55	15.7
Primary smartphone activity	Social media	139	39.7
	Messaging/communication	112	32.0
	Academic/work	58	16.6
	Entertainment/other	41	11.7

Reliability of Study Measures

Internal consistency coefficients ranged from .79 to .86, indicating acceptable to good reliability in the present sample (Table 4).

Table 4

Internal Consistency of Study Measures

Measure	Items	Cronbach's α
Notification Fatigue (adapted)	5	.82
Attentional Control Scale	20	.79
Psychological Wellbeing Scale for Muslim Societies	10	.86

Descriptive Statistics

Descriptive statistics for the three study variables are presented in Table 5. Skewness values ranged from -0.31 to -0.18 and kurtosis values from -0.41 to -0.16 , which did not indicate substantial distributional non-normality.

Table 5

Descriptive Statistics of Study Variables (N = 350)

Variable	<i>M</i>	<i>SD</i>	Min	Max	Skew	Kurt
Notification fatigue	4.31	1.08	1.40	6.80	-0.18	-0.41
Attentional control	53.74	7.21	32.00	72.00	-0.24	-0.16
Psychological well-being	42.86	6.34	25.00	59.00	-0.31	-0.22

Note. Min and Max are observed values. Skew = skewness; Kurt = kurtosis. Notification fatigue is scored as an item mean on a seven-point scale; attentional control and psychological well-being are scored as totals.

Correlational Analysis

Table 6

Pearson Correlations among Study Variables (N = 350)

Variable	1	2	3
1. Notification fatigue	—		
2. Attentional control	$-.24^{***}$	—	
3. Psychological well-being	$-.29^{***}$	$.34^{***}$	—

Note. All tests two-tailed. Ninety-five percent confidence intervals: notification fatigue with attentional control $[-.34, -.14]$; notification fatigue with psychological well-being $[-.38, -.19]$; attentional control with psychological well-being $[.24, .43]$. $^{***}p < .001$.

All three associations were significant and remained so under a Bonferroni-adjusted criterion for three comparisons ($\alpha = .0167$). The corresponding shared variance was 5.8%, 8.4%, and 11.6% respectively. All three alternative hypotheses were supported and the null hypotheses rejected.

Discussion

All three hypothesised associations were statistically significant and in the expected directions. The inverse association between notification fatigue and attentional control is consistent with experimental evidence that notifications impose an attentional cost even without device interaction (Stothart et al., 2015) and that notification sounds are accompanied by slower responding and increased recruitment of cognitive control (Upshaw et al., 2022). The present finding differs in an important respect, however: that work manipulated exposure and measured performance, whereas both variables here are perceptual. The correlation is therefore open to at least three readings – that notification burden erodes attentional capacity, that weaker attentional control makes the same alert volume feel more burdensome, or that both self-reports reflect a common dispositional factor such as trait anxiety, which attentional control theory explicitly links to attentional control (Eysenck et al., 2007). The design cannot adjudicate among these.

The inverse association between notification fatigue and psychological well-being extends the fatigue literature in a direction that has received little attention. Work in the technostress tradition, including Lee et al. (2016), has typically terminated in outcomes internal to technology use rather than in general psychological functioning, while the notification literature has mapped onto stress, anxiety, and fear of missing out (Fitz et al., 2019; Kushlev et al., 2016). The present outcome is eudaimonic functioning as specified by Ryff (1989), suggesting that appraised notification demand relates to positive functioning and not only to distress. The result also sits comfortably alongside the non-linear pattern reported by Fitz et al. (2019): if the cost of notifications were purely a function of volume, disabling them entirely should have been optimal, and it was not – which supports the appraisal-based reading carried over from the transactional stress model (Lazarus & Folkman, 1984).

The strongest association was between attentional control and psychological well-being, and it warrants caution rather than emphasis. Environmental mastery and autonomy, two of Ryff's six components, describe a capacity to manage one's circumstances and regulate one's conduct that overlaps with the self-regulatory content of the ACS. This conceptual overlap may have contributed to the observed association and warrants examination using measures with stronger discriminant validity; that the coefficient exceeds both notification-related coefficients is consistent with such a contribution. Taken together the three coefficients form a coherent but weak pattern. It is tempting to infer a mediational structure in which attentional control transmits the effect of notification fatigue onto well-being, but that inference is not licensed by these data: mediation requires temporal ordering, and a cross-sectional model estimated on three simultaneously measured self-reports would be uninterpretable regardless of fit. The defensible claim is that the three constructs co-vary modestly, in directions consistent with existing theory.

Limitations

- No factor analysis or validity evidence exists for the notification-referenced form of the measure; $\alpha = .82$ is the only psychometric evidence available.
- Discriminant validity against SNS fatigue and problematic smartphone use was not tested, despite 71.7% of the sample using social media or messaging primarily.
- Changing the item referent, and relocating notification content from the stressor side of the parent model to the strain side, was not empirically tested.
- The measure was administered in English to a predominantly Urdu-speaking sample, so measurement equivalence is unestablished.
- A unidimensional ACS total score was used despite evidence for separate focusing and shifting factors (DeVito et al., 2019), and the ACS indexes beliefs about attention rather than performance.
- The PWS-MS retains only positively voiced items, so acquiescent responding cannot be ruled out and only total-score inference is appropriate.
- All variables were self-reported in a single administration with no remedy for common method variance (Podsakoff et al., 2003), and the cross-sectional design precludes causal inference.
- Convenience sampling produced a predominantly student, undergraduate, online sample, and the associations leave 88% to 94% of variance unexplained.

Implications and Future Directions

If appraised notification burden rather than raw volume is the psychologically active element, blanket advice to disable notifications is unlikely to help – a conclusion already suggested by Fitz et al. (2019), whose no-notification condition produced greater anxiety and fear of missing out. Structured strategies such as scheduled batching, application-level triage, and predictable delivery windows fit the present pattern better than abstinence-based approaches, and notification management may be a low-cost addition to student wellbeing provision in Pakistani universities. These are hypotheses for intervention research rather than recommendations from causal evidence. The clearest research priority is instrument development: a notification fatigue measure with documented item generation, factor structure, and discriminant validity against problematic smartphone use, together with an Urdu adaptation showing measurement invariance. Beyond measurement, designs pairing self-reported fatigue with device-logged notification data, longitudinal or experience-sampling designs capable of establishing temporal order, and behavioural indices of attentional control would all strengthen the evidence base.

Conclusion

Notification fatigue was significantly and negatively associated with both attentional control and psychological well-being among young adult smartphone users in Pakistan, and attentional control was positively associated with psychological well-being. All three non-directional hypotheses were supported. The associations were modest in magnitude and cannot support causal claims, and the strength of the conclusions is limited by the psychometric status of the adapted notification fatigue measure. Within these bounds, the study offers preliminary evidence that appraised notification burden is worth distinguishing from notification volume, and that it relates not only to distress but to positive psychological functioning.

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