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Physiological responses to personalized TikTok content: evidence from pupil size and eye blink rate

Haami Yusein[1,2*], Joshua O Eayrs[2,3] and C. Nico Boehler[2]

Abstract

Background Personalized social media platforms rely on algorithmic curation to increase user engagement, yet the physiological mechanisms underlying this process are not well understood. This study investigated whether personalized TikTok content influences ocular markers of engagement, specifically pupil size and spontaneous eye blink rate, in a healthy sample.

Methods A within-subject design was used in which participants viewed both personalized videos (from their own TikTok feed) and non-personalized videos (from a novel account). Eye tracking was employed to record pupil size and spontaneous eye blink rate during video viewing. Differences between conditions were analyzed using within-subject statistical comparisons. Exploratory analyses examined associations between physiological measures and individual differences, including habitual TikTok use, daily usage duration, follower count, and self-reported enjoyment.

Results Pupil size was significantly larger during personalized compared to non-personalized video viewing, indicating increased arousal-related engagement for personalized content. In contrast, spontaneous eye blink rate did not differ between conditions. Exploratory analyses did not reveal consistent associations between physiological measures and individual usage variables.

Conclusions Viewing personalized TikTok content was associated with larger pupil size than viewing non-personalized content, consistent with increased arousal-related engagement. The absence of differences in eye blink rate suggests that reward-related processes may not be differentially affected by personalization, or that this measure may lack sensitivity in this context. Because personalized and non-personalized feeds inherently differ in the content selected for each user, the present design cannot distinguish the contributions of specific content characteristics, such as emotional intensity and familiarity, to the observed physiological response. With these limitations in mind, the findings highlight the potential of physiological measures, particularly pupillometry, for studying engagement in digital media environments.

Keywords TikTok, Social media, Arousal, Pupil size, Personalization

*Correspondence:
Haami Yusein
haami.yusein@ulb.be
[1]Laboratory of Medical Psychology and Addictology, ULB Neuroscience Institute (UNI), Université Libre de Bruxelles (ULB), Avenue F. Roosevelt 50, CP191, Brussels 1050, Belgium
[2]Department of Experimental Psychology, Ghent University, Henri Dunantlaan 2, Ghent, Belgium
[3]Research Centre for Brain and Behaviour, School of Psychology, Liverpool John Moores University, Liverpool, UK

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Background

Research suggests that, on average, individuals spend over four hours daily online, and half of that time is on social media (SM) [1]. Among all SM platforms, TikTok has the highest engagement rate, capturing attention for an average of 66 min a day [2]. To maintain such levels of engagement, SM platforms rely on algorithmic content curation [3]. TikTok's decentralized recommendation system continuously analyzes users' interests to provide personalized content, resulting in high engagement [4].

Although personalization is central to contemporary social media platforms, relatively little is known about how personalized content affects users' moment-to-moment psychological and physiological states. Engagement is often described in terms of increased arousal, sustained attention, and reward-related processing. These processes have been theoretically linked in prior research to catecholaminergic systems, including noradrenergic and dopaminergic mechanisms [5–11]. However, physiological evidence of the effects of personalization remains scarce.

Personalized social media content and arousal

Arousal has been linked to activity in the brain's norepinephrine (NE) system, which is primarily regulated by the locus coeruleus (LC) [12–14]. Converging evidence suggests that pupil diameter covaries with LC activity, with modulations in both tonic and phasic LC firing predicting changes in pupil size [15]. Accordingly, increases in pupil diameter are commonly interpreted as reflecting heightened physiological arousal.

Beyond general arousal, pupil dilation has been associated with subjective experiences of interest and emotional engagement. Early work demonstrated larger pupil responses to stimuli of personal interest [16] and subsequent research has shown that emotionally arousing stimuli, whether positive or negative, reliably elicit greater dilation than neutral material [17–18]. Together, these findings suggest that pupil size is sensitive to motivationally and emotionally salient content.

Taken together, these findings suggest a link between interest, emotion, arousal, and pupil dilation, with implications for research on personalized SM content. Personalized social media platforms such as TikTok are designed to tailor content to individual users' preferences, thereby increasing subjective relevance and engagement. If pupil dilation indexes interest and arousal-related engagement, personalized content should evoke larger pupil responses than non-personalized content. While prior research has linked social media use to heightened arousal, much of this evidence relies on self-report or downstream outcomes (e.g., sleep disturbances) [5–7]. By contrast, the present study uses pupil size to assess arousal during moment-to-moment content engagement.

Social media and dopamine

In addition to its association with arousal, SM use has also been linked to reward-related processes, and by extension the dopaminergic system. Because dopamine (DA) plays a central role in reinforcement learning, motivational salience, and addictive behaviors, some accounts have suggested that highly engaging platforms may recruit mesolimbic DA circuitry [19].

Empirical evidence for dopaminergic involvement in social media use is mixed and varies in scope. Neuroimaging work has reported altered striatal dopamine transporter binding in individuals with Internet Addiction Disorder [9] and structural differences associated with problematic social networking use [20]. However, such findings stem largely from clinical or extreme-use samples and may not generalize to everyday engagement. In non-clinical populations, lower dopamine synthesis capacity has been associated with greater social media interaction [21], suggesting that individual differences in dopaminergic function may shape engagement patterns.

More directly relevant to personalized content, Su et al. [11] found that viewing personalized TikTok content activated the dopaminergic midbrain regions, including the ventral tegmental area (VTA), with stronger recruitment when content is tailored to user preferences. These findings support the hypothesis that DA circuits are recruited during TikTok engagement, particularly when content is tailored to the user's preferences.

As an additional, indirect approach to study the DA system, spontaneous eye blink rate (EBR) has been proposed, based on early pharmacological, clinical, and animal findings linking blink frequency to DA modulation [22–23]. However, evidence for a robust and direct relationship between EBR and DA is mixed: while some studies reported associations with DA receptor activity or reward-related behavior [24], others found weak, absent, or context-dependent effects that vary with task demands, baseline DA functioning, or individual differences [25–28]. Taken together, these findings suggest that, unlike pupil size as an index of arousal, EBR provides at best an indirect and context-sensitive marker of DA-related processes, requiring cautious interpretation in the context of social media research. Given that EBR was recorded alongside pupil size, the primary measure of this study, an analysis of EBR's association with personalized TikTok content may also be informative.

Hypotheses

Taken together, we made two primary predictions. First, we made the directional prediction that if personalized TikTok content increases arousal-related engagement, pupil size should be larger when participants view personalized compared to non-personalized videos. Second, we examined whether spontaneous EBR, as a suggested

indirect and context-sensitive marker of reward-related dopaminergic functioning, differs between personalized and non-personalized content. Given the mixed evidence regarding the strength and direction of EBR–dopamine associations in healthy populations, this analysis was more speculative and non-directional. In addition, we explored whether individual differences in habitual TikTok use, daily usage duration, follower count, and reported enjoyment were associated with pupil size. To test these predictions, we used a within-subject eye-tracking paradigm to assess pupil size and EBR during exposure to personalized and non-personalized TikTok videos in a healthy sample.

Method

Stimuli and apparatus

Personalized TikTok video content was presented using the Microsoft Edge browser, with participants logged into their TikTok accounts. Non-personalized TikTok video content was shown via the generic TikTok website in Google Chrome, without any login. Both conditions are illustrated in Fig. 1. This separation of browsers was intended to keep the personalized and non-personalized conditions clearly distinct while ensuring that the overall viewing experience (e.g., screen size, resolution, and playback quality) remained identical across both conditions.

All TikTok video content was presented on a computer monitor, while eye-tracking data, including pupil size and blink events, was recorded using the EyeLink 1000 + eyetracker. To attenuate the influence of luminance variation on pupil size, the f.lux software was installed on the display computer and configured to reduce blue light emission from the screen. This setting applied to the whole display and was therefore the same in both conditions.

Participants

An a-priori power analysis conducted using G*Power indicated that a sample size of 27 participants would be required to detect a medium effect size ($d = 0.5$) with 80% power at $\alpha = 0.05$, assuming a paired-sample design. Therefore, we aimed to recruit 30 participants. A total of 34 participants (31 female), with a mean age of 19 years (range: 18–23), were tested. Participants were university students recruited through Ghent University's participant recruitment platform, SONA, and received one course credit for the 45-minute session. The study description on SONA stated that participants needed to have their own TikTok account and be able to log into it in the lab. No other eligibility criteria were applied. To support eye-tracking quality and reduce influences on pupil size and blinking, participants were additionally asked to refrain from consuming caffeine on the day of testing, to wear no make-up, and to avoid glasses with black frames. These were requests rather than exclusion criteria. Three of the 34 participants tested were excluded from the analyses based on the data-quality criteria described in the Data Analysis section, leaving a final sample of 31.

We followed the standard ethical procedure required by the Faculty of Psychology and Educational Sciences of Ghent University, as set out in its General Ethics Protocol (available at: https://www.ugent.be/pp/en/research/ec/general_ethics_protocol_fppw.pdf). Under this protocol, formal review by the Faculty's Ethics Committee is required only for studies that meet the mandatory submission criteria defined in its Sect. 3.1. As the present

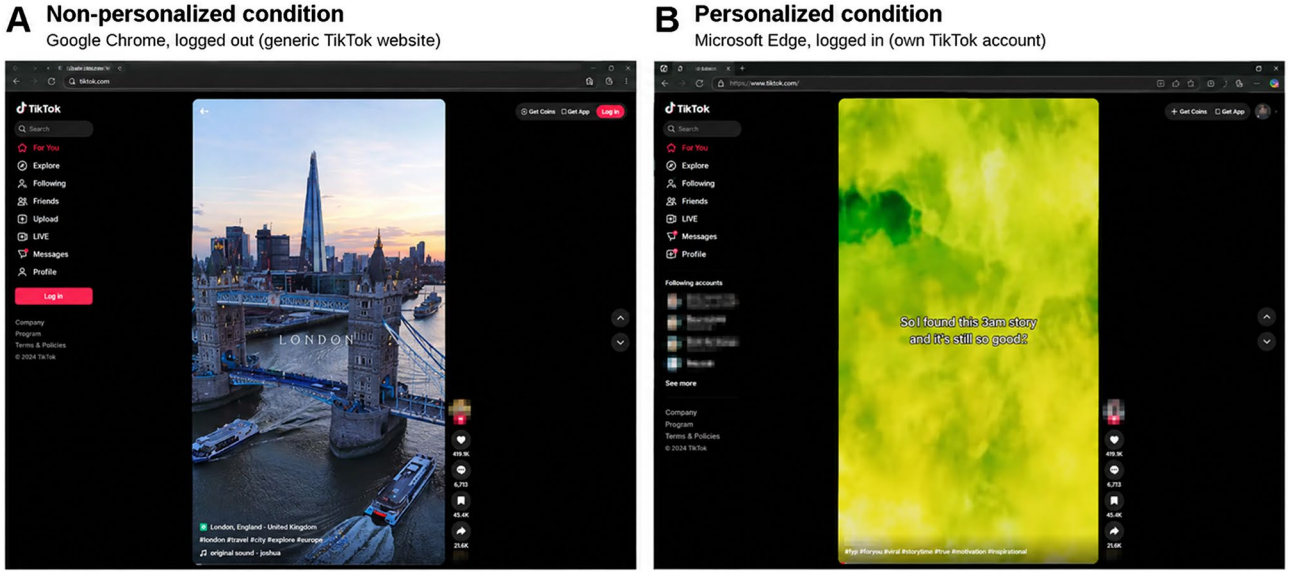

Fig. 1 Example screenshots of the TikTok "For You" page as displayed in (**A**) Google Chrome without login (non-personalized condition) and (**B**) Microsoft Edge with a TikTok account logged in (personalized condition). Account names, profile pictures, and creator names have been blurred

study did not involve deception, vulnerable populations, or physical or psychological risk, it did not require formal review. The study was conducted in accordance with the principles of the 1964 Declaration of Helsinki and its later amendments. All participants provided written informed consent prior to participation.

Research procedure

The study followed a within-subjects design, with two main conditions: personalized and non-personalized TikTok content. Each condition included two blocks, resulting in four blocks per participant. The order of conditions was counterbalanced: participants with an odd participant number viewed personalized TikTok video content in blocks 1 and 3, and non-personalized TikTok video content in blocks 2 and 4; the reverse order was used for even-numbered participants. Each block lasted five minutes.

The experimental procedure was conducted in a dimly lit room, with participants seated comfortably and their heads stabilized using a chin rest. Upon arrival, participants securely logged into their TikTok accounts using a QR code scanner on their mobile device, allowing access to personalized TikTok video content in the Microsoft Edge browser without entering their passwords on the lab computer. This login method ensured both convenience and data privacy.

Participants were informed that the experiment included two viewing conditions (personalized vs. non-personalized video content) and were instructed to watch TikTok video content as they normally would at home. Participants could scroll to the next video by pressing the "next video button", using the down arrow key, or return to a previous video using the "previous video button", using the up arrow key.

Eye-tracking data was recorded using the EyeLink 1000 + system throughout the experiment, along with video-skipping behavior. Data was captured from the right eye. Before each block, a standard 9-point eye-tracker calibration procedure was used, including a drift correction check. Between blocks, participants were given a 30-second break during which they were asked to fixate on a neutral grey screen. This interval was used to ensure that EBR and pupil size returned to baseline before continuing.

After completing the experimental blocks, participants provided demographic information (age and gender) and completed a short four-item questionnaire on TikTok usage patterns and enjoyment of the platform. The questionnaire was developed by the authors for this study and has not been published elsewhere; an English version is provided as Supplementary Material S1. Usage-related questions were: "How often do you use TikTok?", "How many hours on average per day do you spend on TikTok?", "Please enter the number of followers you have on TikTok," and "How much do you enjoy using TikTok?". Daily TikTok use was operationalized as the average number of hours per day participants reported using TikTok over the past week and served as a continuous indicator of usage intensity. Habitual TikTok use was measured on a 5-point Likert scale ranging from 0 (Never) to 4 (Daily), reflecting how regularly participants engaged with the platform. In addition, TikTok enjoyment was assessed using a separate 5-point Likert scale ranging from 0 (No enjoyment) to 4 (A great deal of enjoyment).

Data analysis

To identify outliers in pupil size and EBR, z-scores were calculated for each participant within each condition. Values with an absolute z-score greater than ± 2.5 were considered outliers. One participant exceeded this threshold and was excluded from the dataset. Another participant was excluded due to an extreme discrepancy in EBR between conditions (EBR per minute of 10 in the personalized condition vs. 0.5 in the non-personalized condition), indicating possible non-compliance with the task instructions or bad data due to poor blink detection. One additional participant was excluded due to insufficient data. After these exclusions, 31 participants remained in the final sample.

Pupil size data was linearly interpolated around blink events using a symmetrical ± 90 ms buffer (i.e., a total window of 180 ms surrounding each blink). This was done to exclude contaminated data both immediately before and after the blink and to ensure continuity in the signal during brief data loss (e.g., during blinks). The success of this standard procedure was visually controlled, which was done in a fashion that was blind towards the conditions.

For EBR, eye blink events were detected using EyeLink's integrated event system, which logs the onset and offset of each blink. Following prior literature [29], only blinks with durations between 160 ms and 1000 ms were retained for analysis, with shorter or longer durations considered noise. Additionally, consecutive short blinks occurring within 500 ms of each other were merged if their combined duration fell within the 160–1000 ms range. Valid blinks were then counted and converted into blink rates (blinks per minute).

For the main analyses, the dependent variables were pupil size and EBR, respectively, while the independent variable was the condition (Personalized vs. Non-personalized TikTok video content). Since both EBR and pupil size were not normally distributed, as indicated by significant Shapiro-Wilk test results ($p < .05$), nonparametric tests were used. To address Hypothesis 1 (i.e., larger pupil size for the personalized content condition compared to the non-personalized condition) a one-sided

Wilcoxon signed-rank test was conducted to compare pupil size across the two conditions. For Hypothesis 2 (i.e., a potential difference in EBR between the personalized and non-personalized conditions), a two-sided Wilcoxon signed-rank test was conducted, due to the undirected nature of the hypothesis. Three participants had identical blink rates in both conditions; as is standard for the Wilcoxon signed-rank test, these zero-difference pairs were dropped ($n = 28$). For both hypotheses, Bayes factors (BF_{10}) were additionally calculated to quantify the relative evidence for the alternative and null hypotheses. All analyses were conducted in R (RStudio version 2024.09.0 + 375), and Bayes factors were computed using the default priors implemented in the software.

As part of the exploratory analyses, we examined participants' scrolling behavior, operationalized as the number of "next video" button presses, across content conditions and blocks. Inspection of the data and a Shapiro-Wilk test indicated that the distribution of scroll counts did not violate the assumption of normality. Therefore, a paired t-test was used to compare scrolling behavior across both video conditions.

Further, exploratory analyses were conducted to examine the relationship between TikTok use patterns and pupil size. Specifically, we investigated whether pupil size was associated with (1) daily TikTok use, (2) frequency of TikTok use, and (3) TikTok follower count, across both content conditions. In addition, we explored whether these TikTok usage variables were related to participants' perceived enjoyment of the platform. Given that several variables were ordinal in nature (e.g., daily TikTok use, frequency of TikTok use, and enjoyment) and others exhibited non-normal distributions (e.g., follower count), associations were assessed using Spearman rank-order correlations. Correlation coefficients are therefore reported as Spearman's ρ.

P-values below the conventional threshold of 0.05 were considered statistically significant. Due to the use of non-parametric tests, effect sizes are reported using r, calculated as $r = \frac{z}{\sqrt{N}}$ where Z is the Wilcoxon test statistic and N is the number of observations.

Results

Descriptive

In the current study, our sample reported an average TikTok use of 2 h daily (range = 1–5) with all but 6 participants indicating everyday use of the app. The average follower count of our participants amounted to 156 (range = 0–1250).

Pupil size

Turning to our first main hypothesis, we tested whether pupil size was larger when viewing personalized TikTok video content compared to video content from a novel account (non-personalized content). On average, pupil size was indeed significantly larger in the personalized content condition ($M = 2239.1$, $SD = 736.3$, 95% CI [1969.1, 2509.2]) compared to the non-personalized condition ($M = 2137.5$, $SD = 732.7$, 95% CI [1868.8, 2406.2], V = 365, $z = 2.29$, $p = .01$, $r = .41$, $BF_{10} = 9.16$), supporting H1 (Fig. 2).

Blink rate

We investigated whether EBR differed between the personalized and non-personalized TikTok video content conditions. We found that EBR did not significantly differ between the personalized TikTok video content condition ($M = 3.66$, $SD = 2.58$, 95% CI [2.72, 4.61]) and the non-personalized TikTok video content condition ($M = 3.96$, $SD = 2.47$, 95% CI [3.05, 4.86]), V = 151, $z = -1.173$, $p = .24$, $r = -.21$, BF10 = 0.35; Fig. 3).

Exploratory analyses

Exploratorily, a paired t-test in scrolling behavior, defined as the number of "next video" presses, revealed a non-significant difference between the personalized ($M = 73.10$, $SD = 35.27$, 95% CI [61.10, 86.03]) and non-personalized ($M = 82.26$, $SD = 43.03$, 95% CI [67.71, 97.58]) TikTok content conditions, t(30) = -1.27, $p = .21$, BF10 = 0.4, $d = -0.23$.

The exploratory correlations revealed no significant associations between TikTok use variables (daily use, habitual use, follower count, or perceived enjoyment) and pupil size in either the personalized or non-personalized content conditions (all $ps > 0.05$). Additional analyses correlating the same TikTok use variables with pupil-size difference (i.e., personalized vs. non-personalized) did not reach significance (all $ps > 0.05$).

Nonetheless, follower count did significantly correlate with perceived enjoyment (ρ =.

0.41, $p = .02$). Additionally, the correlation between daily TikTok use and perceived enjoyment also appeared to be significant (ρ = 0.40, $p = .03$). A significant relationship was also observed between habitual TikTok use and perceived enjoyment (ρ = 0.55, $p = .001$), suggesting that the more often the app is used, the more enjoyment one reports from it.

Discussion

The present study aimed to investigate the effects of personalized TikTok video content on physiological markers associated with arousal and reward-related processes. Pupil size was significantly larger during personalized compared to non-personalized content, suggesting heightened arousal-related engagement. In contrast, eye-blink rate (EBR) did not differ between conditions, thereby failing to implicate reward-related processes.

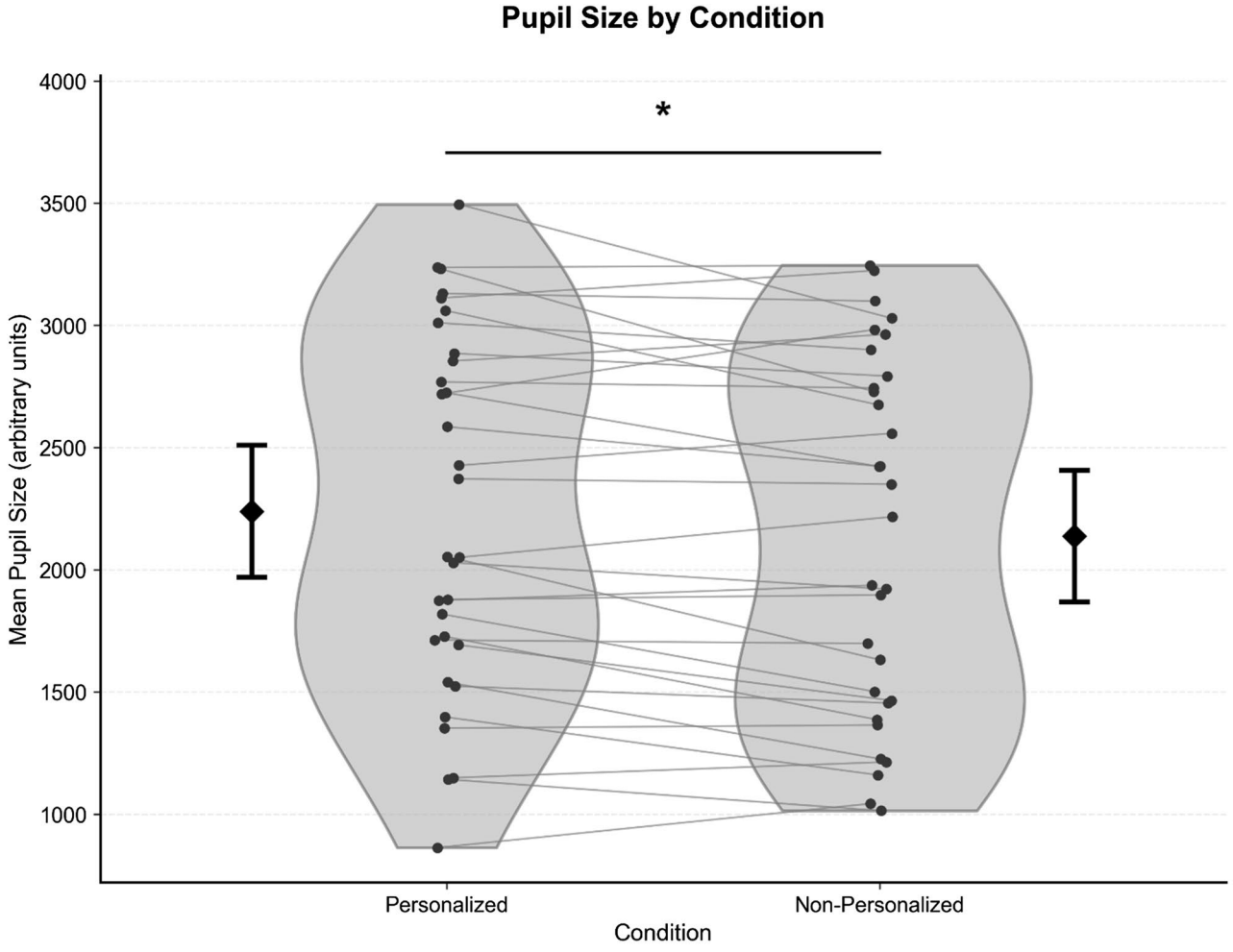

Fig. 2 Violin plots show the distribution of participants' mean pupil size (in arbitrary units) for personalized and non-personalized TikTok video content. Dots represent individual participants, and grey lines connect each participant's values in the two conditions. Black diamonds and error bars show the group mean and its 95% confidence interval. The bracket marks the comparison between conditions (one-sided Wilcoxon signed-rank test; an asterisk indicates $p < .05$)

Exploratory analyses revealed no significant associations between pupil size and self-reported TikTok use. Still, perceived enjoyment was positively related to how much participants used it, as well as to their follower count.

Pupil size

The first hypothesis, predicting an increase in pupil size in the personalized content condition, was supported by the results: pupil size was significantly larger during personalized content compared to non-personalized content. This finding aligns with prior work linking pupil dilation to interest and arousal [13, 16, 30]. Personalized TikTok videos are algorithmically selected to match users' preferences, and the observed pupil enlargement is consistent with the idea that such tailoring might translate into stronger arousal-related engagement.

These findings also speak to broader claims made by the arousal hypothesis, which posits that consumption of SM content might be problematic for sleep because of increased arousal [5–7]. While the current paradigm did not include any direct measurements of sleep, the observed increase in arousal may have implications for sleep, given that factors like heightened arousal and stress are generally associated with poorer sleep quality [31]. Notably, prior studies using EEG, heart rate, or heart rate variability have yielded mixed support for arousal-based accounts of social media effects [32, 33]. The current findings suggest that pupillometry may capture aspects of arousal-related engagement not consistently detected by other physiological measures.

A potential confound in interpreting pupil size differences is variation in video features, such as luminance, as pupil diameter is very sensitive to changes in light intensity [34–36]. However, because TikTok videos vary widely in brightness and were presented in a random sequence in both conditions and across participants,

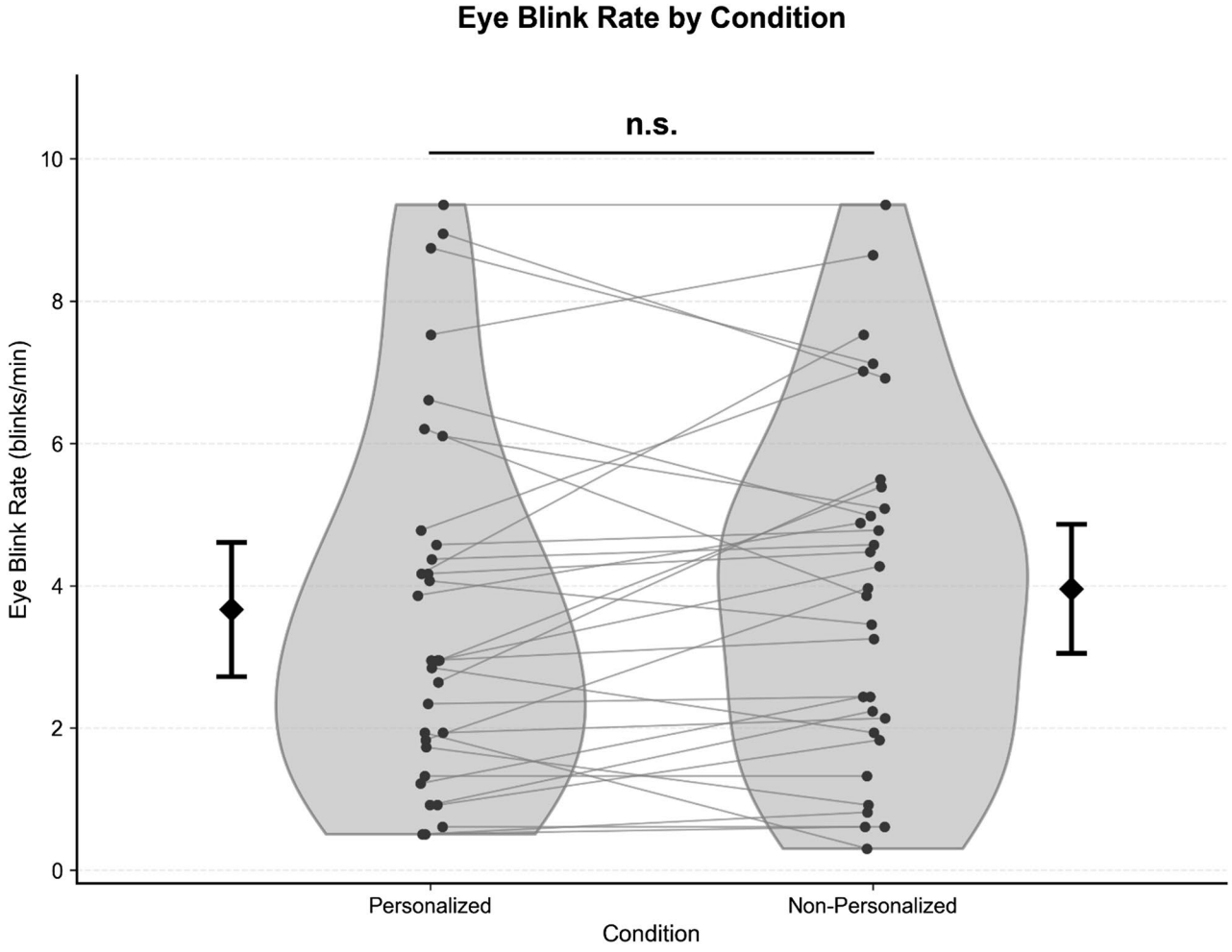

Fig. 3 Violin plots show the distribution of participants' mean eye blink rate (blinks/minute) in the personalized and non-personalized TikTok video content conditions. Dots represent individual participants, and grey lines connect each participant's values in the two conditions. Black diamonds and error bars show the group mean and its 95% confidence interval (n.s. = not significant; two-sided Wilcoxon signed-rank test)

large systematic luminance differences between the personalized and non-personalized conditions appear unlikely. The heterogeneity and random ordering of videos should have minimized consistent brightness biases across conditions. We further tried to attenuate any such effects by reducing the amount of blue light, which is particularly relevant for pupillary light adaptations [37]. This blue-light filter was applied to the whole display, and thus equally in both conditions.

Another potential confound concerns differences in scrolling behavior across conditions, as more frequent video transitions could introduce additional luminance changes that might influence pupil size. However, exploratory analyses indicated that the number of 'next video' button presses did not significantly differ between the personalized and non-personalized conditions, and Bayesian analysis provided anecdotal evidence in favor of the null hypothesis. This suggests that participants did not systematically scroll more in one condition than the other, making it unlikely that differences in scrolling behavior can account for the observed pupil size differences.

At the neurobiological level, pupil size has frequently been linked to activity in the locus coeruleus–norepinephrine (LC–NE) system [12–14]. However, converging evidence indicates that pupil dynamics reflect contributions from multiple neuromodulatory systems. For example, Reimer et al. [38] demonstrated in mice that both acetylcholine (ACh) and NE activity covary with pupil size, with ACh tracking sustained pupil diameter and NE more strongly associated with rapid changes (with the present data not explicitly dissociating such effects due to the ongoing nature of the visual stimulation). Human pharmacological studies further support cholinergic modulation of pupil diameter [39, 40]. Moreover, resting-state fMRI work has shown that spontaneous pupil fluctuations correlate with activity across several nuclei of the ascending arousal system, including LC, VTA, substantia

nigra, median raphe, and basal forebrain [41]. While the present approach therefore does not permit direct conclusions about any specific neurotransmitter system, the findings are consistent with the notion that personalized content is associated with greater overall arousal-system engagement.

Eye blink rate

In contrast to pupil size, EBR did not differ between personalized and non-personalized conditions. One possible explanation concerns the interpretation of EBR as a proxy for DA activity. Although early pharmacological and clinical findings linked EBR to dopaminergic modulations [22, 23, 42, 43], more recent work in healthy populations has reported inconsistent or context-dependent associations. For example, Demiral et al. [26] reported reduced EBR following methylphenidate administration, whereas Dang et al. [25] found no relationship between baseline DA receptor availability and EBR after DA agonist administration.

Interestingly, participants exhibited generally low EBR across both conditions (M = 3.81 blinks per minute), substantially lower than the typically observed resting-state rate of approximately 17 blinks per minute, but comparable to rates observed during cognitively demanding tasks such as reading [44]. Although participants were not informed that EBR was of interest, reducing the likelihood of deliberate blink suppression, prior experience with eye-tracking paradigms cannot be fully ruled out as a potential influence. Moreover, low EBR may generally reflect sustained attentional engagement with TikTok content. Blink inhibition has been shown to occur for visually salient or task-relevant stimuli [45], with participants reliably blinking less during engaging scenes. From this perspective, both personalized and non-personalized TikTok videos may have been sufficiently engaging to suppress blinking overall, thereby reducing variability between conditions. Interpretation is further complicated by the possibility that EBR also reflects overlapping influences from multiple neuromodulatory systems. For example, cholinergic manipulations have also been shown to affect blink rate [39]. In contexts where engagement and reward-related processes co-occur, these influences may operate in opposing directions, complicating straightforward interpretation of EBR as a dopaminergic marker. The present findings therefore underscore the challenges of using EBR as a simple proxy for dopamine-related processes in naturalistic media settings. This is further qualified by the fact that in a Bayesian analysis, we only observed anecdotal evidence for the absence of an effect of content personalization on EBR.

Exploratory analysis

Scrolling behavior did not significantly differ between conditions, although participants tended to scroll slightly more during non-personalized content. This numerical pattern is consistent with the notion that personalized feeds better match users' interests, reducing the need to actively search for more appealing material, but was not reliably expressed here. This might relate to the short duration of typical TikTok videos. The most popular TikTok videos tend to be between 14 and 16 s long [4], leaving limited time for active scrolling behavior. Such effects could have obscured any condition-based differences that may have been expressed more clearly for longer videos. Still, under the present conditions, one may speculate that the present finding of increased pupil size for personalized content could be a more sensitive marker of engagement (and by extension longer-term use patterns) than behavioral aspects such as scrolling behavior. Importantly, pupil size was not associated with any of the self-reported usage variables in the present sample, so the present data provide no evidence for a link between pupil size and longer-term use patterns.

A significant positive correlation emerged between follower count and self-reported TikTok enjoyment. One possible explanation is behavioral: individuals who enjoy TikTok more may spend more time on the platform, increasing opportunities to accumulate followers, consistent with the observed associations between enjoyment and both habitual and daily use. Alternatively, follower count may reflect underlying personality traits such as extraversion. Extraverted individuals tend to engage more actively with SM, posting content, interacting with others, and perceiving the platform more positively [46], behaviors that may facilitate follower growth. Given that extraversion is also associated with positive affect [47], greater enjoyment may partly reflect dispositional tendencies linked to both social engagement and follower accumulation. In summary, the exploratory analyses presented here sketch a relatively consistent pattern concerning the relationship of different variables related to TikTok use and enjoyment, but without correlating with pupil size, which may indicate that short-term arousal-related engagement is not strongly associated with these more long-term variables.

Limitations

Several limitations should be considered when interpreting the present findings. First, the personalized and non-personalized feed conditions were defined by whether or not participants were logged into their individual account. Coupled with the use of different browsers (Microsoft Edge and Google Chrome) to facilitate this manipulation, this meant that there were several superficial differences between the two displays (Fig. 1). For

example, the logged-out page showed a log-in button and a shorter navigation menu without the list of followed accounts. Future studies might consider presenting both feeds in the same browser (e.g., using separate browser profiles or incognito browsing for one condition) with identical window layouts.

Second, the videos themselves were not controlled or matched across conditions. This reflects the naturalistic design of the study, in which each participant viewed their own algorithmically curated feed. Consequently, the personalized and non-personalized conditions may have differed systematically in characteristics such as emotional intensity, familiarity (e.g., known creators, formats, or topics), and personal relevance; recognizing previously encountered material has likewise been associated with larger pupil responses [48]. These characteristics are not necessarily independent of personalization, but may represent mechanisms through which algorithmic curation produces increased engagement. The present design therefore does not allow us to determine which specific properties of personalized content contributed to the observed difference in pupil size. Future studies could record and systematically code the videos presented in each condition (e.g., content category, emotional intensity, and familiarity) to disentangle these potential contributions while retaining the naturalistic differences produced by personalization.

Third, our study lacked ecological validity regarding typical TikTok viewing. Specifically, TikTok was viewed in a desktop browser with the head stabilized in a chin rest, which differs substantially from typical smartphone use. Future studies could therefore examine TikTok content under more naturalistic viewing conditions, such as on a smartphone and without head stabilization, to assess whether the present findings generalize to everyday TikTok use.

Conclusion

TikTok is among the most widely used social media platforms worldwide, yet its impact on automatic arousal has remained largely understudied with earlier work based on EEG and cardiac measures yielding inconsistent results. The present study shows that viewing algorithmically personalized TikTok content was accompanied by larger pupil size than viewing non-personalized content, which is consistent with heightened engagement of the ascending arousal system during personalized media consumption. In contrast, eye-blink rate did not differ significantly between conditions, underscoring the complexity of interpreting this measure in healthy populations. Exploratory analyses further indicated that daily, habitual use and follower count were associated with greater self-reported enjoyment of using TikTok, but not with pupil size. Overall, the findings are consistent with the idea that personalization amplifies moment-to-moment arousal-related engagement, and they identify pupil size as a promising measure in this context. However, because personalized and non-personalized feeds inherently differ in the content selected for each user, the present study cannot determine which specific content characteristics contribute to the observed physiological response; future research could examine these contributions by systematically coding the content presented in each condition. More broadly, the results illustrate both the promise and the limitations of ocular physiological measures for investigating how algorithmically curated digital environments interact with neurocognitive systems involved in attention and arousal.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s44247-026-00313-5.

Supplementary Material 1:TikTok Questionnaire (.pdf). English version of the four-item questionnaire on TikTok use that was developed for this study.

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Author contributions
HY contributed to the experimental design, the data collection, the data analysis, and the writing and editing of the manuscript. NB contributed to the experimental design and the editing of the manuscript. JE contributed to the experimental design and the editing of the manuscript.

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Data availability
The eye-tracking data generated and analysed in this study, comprising pupil size and eye blink rate recordings, are publicly available in the Open Science Framework (OSF) repository under the project title "Physiological responses to personalized TikTok content: Evidence from pupil size and eye blink rate". The repository can be accessed through the following link: https://doi.org/10.17605/OSF.IO/FKAVM.

Declarations

Ethics approval and consent to participate
We followed the standard ethical procedure required by the Faculty of Psychology and Educational Sciences of Ghent University, as set out in its General Ethics Protocol (available at: https://www.ugent.be/pp/en/research/ec/general_ethics_protocol_fppw.pdf). Under this protocol, formal review by the Faculty's Ethics Committee is required only for studies that meet the mandatory submission criteria defined in its Sect. 3.1. As the present study did not involve deception, vulnerable populations, or physical or psychological risk, it did not require formal review. The study was conducted in accordance with the principles of the 1964 Declaration of Helsinki and its later amendments. All participants provided written informed consent prior to participation.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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References

1. Kepios. Digital around the world. DataReportal; 2025 [cited 2026 Mar 5]. Available from: https://datareportal.com/global-digital-overview.
2. De Marez L, Georges A, Sevenhant R, Devos E. Imec.digimeter.2024: digitale trends in Vlaanderen. Leuven: imec; 2025.
3. Montag C, Yang H, Elhai JD. On the Psychology of TikTok Use: A First Glimpse From Empirical Findings. Front Public Health. 2021;9:641673. https://doi.org/10.3389/fpubh.2021.641673.
4. Chen Z, He Q, Mao Z, Chung HM, Maharjan S. A study on the characteristics of Douyin short videos and implications for edge caching. In: Proceedings of the ACM Turing Celebration Conference - China. 2019. p. 1–6. Available from: https://doi.org/10.1145/3321408.3323082.
5. Bauducco S, Pillion M, Bartel K, Reynolds C, Kahn M, Gradisar M. A bidirectional model of sleep and technology use: a theoretical review of how much, for whom, and which mechanisms. Sleep Med Rev. 2024;76:101933. Available from: https://doi.org/10.1016/j.smrv.2024.101933.
6. Kinsella JE, Chin BN. Mechanisms linking social media use and sleep in emerging adults in the United States. Behav Sci (Basel). 2024;14(9):794. Available from: https://doi.org/10.3390/bs14090794.
7. Woods HC, Scott H. #Sleepyteens: social media use in adolescence is associated with poor sleep quality, anxiety, depression and low self-esteem. J Adolesc. 2016;51:41–9. Available from: https://doi.org/10.1016/j.adolescence.2016.05.008.
8. Eyal N. Hooked: how to build habit-forming products. New York: Portfolio; 2014.
9. Hou H, Jia S, Hu S, Fan R, Sun W, Sun T, et al. Reduced striatal dopamine transporters in people with internet addiction disorder. J Biomed Biotechnol. 2012;2012:854524. Available from: https://doi.org/10.1155/2012/854524.
10. Macit HB, Macit G, Güngör O. A research on social media addiction and dopamine driven feedback. J Mehmet Akif Ersoy Univ Econ Adm Sci Fac. 2018;5(3):882–97. Available from: https://doi.org/10.30798/makuiibf.435845.
11. Su C, Zhou H, Gong L, Teng B, Geng F, Hu Y. Viewing personalized video clips recommended by TikTok activates default mode network and ventral tegmental area. Neuroimage. 2021;237:118136. Available from: https://doi.org/10.1016/j.neuroimage.2021.118136.
12. Berridge CW. Noradrenergic modulation of arousal. Brain Research Reviews. 2007;58(1):1–17. Available from: https://doi.org/10.1016/j.brainresrev.2007.10.013.
13. Berridge CW, Waterhouse BD. The locus coeruleus–noradrenergic system: modulation of behavioral state and state-dependent cognitive processes. Brain Res Rev. 2003;42(1):33–84. Available from: https://doi.org/10.1016/s0165-0173(03)00143-7.
14. Robbins TW. Cortical noradrenaline, attention and arousal. Psychol Med. 1984;14(1):13–21. Available from: https://doi.org/10.1017/s0033291700003032.
15. Joshi S, Li Y, Kalwani RM, Gold JI. Relationships between pupil diameter and neuronal activity in the locus coeruleus, colliculi, and cortex. Neuron. 2016;89(1):221–34. Available from: https://doi.org/10.1016/j.neuron.2015.11.028.
16. Hess EH, Polt JM. Pupil size as related to interest value of visual stimuli. Science. 1960;132(3423):349–50. Available from: https://doi.org/10.1126/science.132.3423.349.
17. Bradley MM, Miccoli L, Escrig MA, Lang PJ. The pupil as a measure of emotional arousal and autonomic activation. Psychophysiology. 2008;45(4):602–7. Available from: https://doi.org/10.1111/j.1469-8986.2008.00654.x.
18. Henderson RR, Bradley MM, Lang PJ. Emotional imagery and pupil diameter. Psychophysiology. 2018;55(6):e13050. Available from: https://doi.org/10.1111/psyp.13050.
19. Wyatt Z. Wired for Want: How Dopamine Drives the New Epidemic of Everyday Addictions. Psychiatry Behav Health. 2025;4(1):1–6.
20. He Q, Turel O, Bechara A. Brain anatomy alterations associated with social networking site (SNS) addiction. Sci Rep. 2017;7(1):45064. Available from: https://doi.org/10.1038/srep45064.
21. Westbrook A, Ghosh A, Van Den Bosch R, Määttä JI, Hofmans L, Cools R. Striatal dopamine synthesis capacity reflects smartphone social activity. iScience. 2021;24(5):102497. Available from: https://doi.org/10.1016/j.isci.2021.102497.
22. Karson CN. Spontaneous eye-blink rates and dopaminergic systems. Brain. 1983;106(3):643–53. Available from: https://doi.org/10.1093/brain/106.3.643.
23. Groman SM, James AS, Seu E, Tran S, Clark TA, Harpster SN, et al. In the blink of an eye: relating positive-feedback sensitivity to striatal dopamine D2-like receptors through blink rate. J Neurosci. 2014;34(43):14443–54. Available from: https://doi.org/10.1523/jneurosci.3037-14.2014.
24. Jongkees BJ, Colzato LS. Spontaneous eye blink rate as predictor of dopamine-related cognitive function—a review. Neurosci Biobehav Rev. 2016;71:58–82. Available from: https://doi.org/10.1016/j.neubiorev.2016.08.020.
25. Dang LC, Samanez-Larkin GR, Castrellon JJ, Perkins SF, Cowan RL, Newhouse PA, et al. Spontaneous eye blink rate (EBR) is uncorrelated with dopamine D2 receptor availability and unmodulated by dopamine agonism in healthy adults. eNeuro. 2017;4(5):ENEURO.0211-17.2017. Available from: https://doi.org/10.1523/eneuro.0211-17.2017.
26. Demiral ŞB, Manza P, Biesecker E, Wiers C, Shokri-Kojori E, McPherson K, et al. Striatal D1 and D2 receptor availability are selectively associated with eye-blink rates after methylphenidate treatment. Commun Biol. 2022;5(1):1015. Available from: https://doi.org/10.1038/s42003-022-03979-5.
27. Mathar D, Wiehler A, Chakroun K, Goltz D, Peters J. A potential link between gambling addiction severity and central dopamine levels: evidence from spontaneous eye blink rates. Sci Rep. 2018;8(1):13371. Available from: https://doi.org/10.1038/s41598-018-31531-1.
28. Simkute D, Nagula I, Tarailis P, Burkauskas J, Griskova-Bulanova I. Internet usage habits and experienced levels of psychopathology: a pilot study on association with spontaneous eye blinking rate. J Pers Med. 2021;11(4):288. Available from: https://doi.org/10.3390/jpm11040288.
29. Hollander J, Huette S. Extracting blinks from continuous eye-tracking data in a mind wandering paradigm. Conscious Cogn. 2022;100:103303. Available from: https://doi.org/10.1016/j.concog.2022.103303.
30. España RA, Schmeichel BE, Berridge CW. Norepinephrine at the nexus of arousal, motivation and relapse. Brain Res. 2016;1641(Pt B):207–16. Available from: https://doi.org/10.1016/j.brainres.2016.01.002.
31. Vandekerckhove M, Cluydts R. The emotional brain and sleep: an intimate relationship. Sleep Med Rev. 2010;14(4):219–26. Available from: https://doi.org/10.1016/j.smrv.2010.01.002.
32. Combertaldi SL, Ort A, Cordi M, Fahr A, Rasch B. Pre-sleep social media use does not strongly disturb sleep: a sleep laboratory study in healthy young participants. Sleep Med. 2021;87:191–202. Available from: https://doi.org/10.1016/j.sleep.2021.09.009.
33. Sennock S, Wilkau KVLU, Günther A, Brandhorst I, Zinke K, Conzelmann A, et al. Investigation of the influence of 45-minute pre-sleep social media use on sleep quality and memory consolidation in adolescents. Sleep Med. 2024;124:299–307. Available from: https://doi.org/10.1016/j.sleep.2024.09.034.
34. Guillon M, Dumbleton K, Theodoratos P, Gobbe M, Wooley CB, Moody K. The effects of age, refractive status, and luminance on pupil size. Optom Vis Sci. 2016;93(9):1093–100. Available from: https://doi.org/10.1097/opx.0000000000000893.
35. Kappauf WE. Variation in the size of the cat's pupil as a function of stimulus brightness. J Comp Psychol. 1943;36(2):125–31. Available from: https://doi.org/10.1037/h0062281.
36. Mathur A, Gehrmann J, Atchison DA. Influences of luminance and accommodation stimuli on pupil size and pupil center location. Invest Ophthalmol Vis Sci. 2014;55(4):2166. Available from: https://doi.org/10.1167/iovs.13-13492.
37. Zaidi FH, Hull JT, Peirson SN, Wulff K, Aeschbach D, Gooley JJ, et al. Short-wavelength light sensitivity of circadian, pupillary, and visual awareness in humans lacking an outer retina. Curr Biol. 2007;17(24):2122–8. Available from: https://doi.org/10.1016/j.cub.2007.11.034.
38. Reimer J, McGinley MJ, Liu Y, Rodenkirch C, Wang Q, McCormick DA, et al. Pupil fluctuations track rapid changes in adrenergic and cholinergic activity in cortex. Nat Commun. 2016;7:13289. Available from: https://doi.org/10.1038/ncomms13289.
39. Naicker P, Anoopkumar-Dukie S, Grant GD, Neumann DL, Kavanagh JJ. Central cholinergic pathway involvement in the regulation of pupil diameter, blink rate and cognitive function. Neuroscience. 2016;334:180–90. Available from: https://doi.org/10.1016/j.neuroscience.2016.08.009.
40. Nuzzi R, Bojino A, Polito MS, Luppi C, Tridico F, Massaia M. The pupil diameter as a possible indicator of neurodegenerative diseases and response to

acetylcholinesterase inhibitors therapy: in-depth measurements following topical administration of tropicamide and pilocarpine. Am J Alzheimers Dis Other Demen. 2020;35:1533317520951693. Available from: https://doi.org/10.1177/1533317520951693.
41. Lloyd B, De Voogd LD, Mäki-Marttunen V, Nieuwenhuis S. Pupil size reflects activation of subcortical ascending arousal system nuclei during rest. eLife. 2023;12:e87865. Available from: https://doi.org/10.7554/elife.84822.
42. Kotani M, Kiyoshi A, Murai T, Nakako T, Matsumoto K, Matsumoto A, et al. The dopamine D1 receptor agonist SKF-82958 effectively increases eye blinking count in common marmosets. Behav Brain Res. 2016;300:25–30. Available from: https://doi.org/10.1016/j.bbr.2015.11.028.
43. Taylor JR, Elsworth JD, Lawrence MS, Sladek JR, Roth RH, Redmond DE. Spontaneous blink rates correlate with dopamine levels in the caudate nucleus of MPTP-treated monkeys. Exp Neurol. 1999;158(1):214–20. Available from: https://doi.org/10.1006/exnr.1999.7093.
44. Bentivoglio AR, Bressman SB, Cassetta E, Carretta D, Tonali P, Albanese A. Analysis of blink rate patterns in normal subjects. Mov Disord. 1997;12(6):1028–34. Available from: https://doi.org/10.1002/mds.870120629.
45. Ranti C, Jones W, Klin A, Shultz S. Blink rate patterns provide a reliable measure of individual engagement with scene content. Sci Rep. 2020;10(1):8267. Available from: https://doi.org/10.1038/s41598-020-64999-x.
46. Bowden-Green T, Hinds J, Joinson A. How is extraversion related to social media use? A literature review. Pers Individ Dif. 2020;164:110040. Available from: https://doi.org/10.1016/j.paid.2020.110040.
47. Lucas RE, Fujita F. Factors influencing the relation between extraversion and pleasant affect. J Pers Soc Psychol. 2000;79(6):1039–56. Available from: https://doi.org/10.1037/0022-3514.79.6.1039.
48. Võ MLH, Jacobs AM, Kuchinke L, Hofmann M, Conrad M, Schacht A, et al. The coupling of emotion and cognition in the eye: introducing the pupil old/new effect. Psychophysiology. 2008;45(1):130–40. Available from: https://doi.org/10.1111/j.1469-8986.2007.00606.x.

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