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RESEARCH ARTICLE



Adolescents' intentional and unintentional cyberhate exposure in Estonia, Finland, Germany, Italy, Poland, and Portugal: The role of perceived discrimination and digital literacy

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ABSTRACT

Cyberhate refers to hateful and biased online content that targets people based on their group membership. This study differentiates between intentional and unintentional cyberhate exposure and examines the role of perceived discrimination, with five dimensions of digital literacy as mediators. Data were collected via a three-wave longitudinal survey conducted over the span of three years (2021–2023) with 2,660 adolescents (aged 14–17 in W3) from six European countries (Estonia, Finland, Germany, Italy, Poland, and Portugal). A cross-lagged panel model shows that perceived discrimination predicts both types of cyberhate exposure and that there are differences in digital literacy dimensions. Technical and operational skills increased intentional cyberhate exposure. Programming skill increased both types of cyberhate exposure. Communication and interaction literacy decreased intentional cyberhate exposure. And information navigation literacy decreased unintentional cyberhate exposure. The indirect effects were analogous – technical and operational skills led to higher un/intentional cyberhate exposure in the preceding year, whereas communication and interaction literacy led to less intentional exposure, and information, navigation, and processing literacy led to less unintentional exposure in the last year. The implications for digital literacy curricula are discussed.

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KEYWORDS

Cyberhate; adolescents;
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discrimination; longitudinal

IMPACT SUMMARY

Prior State of Knowledge: Cyberhate harms youth and society, particularly discriminated adolescents, who face a higher risk of exposure. Digital literacy affects their experiences, but the impact of its various dimensions on un/intentional cyberhate exposure is still not fully understood.

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Novel Contributions: We advance the social compensation hypothesis by applying it to cyberhate and differentiating intentional and unintentional cyberhate exposure; revealing the distinct roles of digital literacy dimensions in adolescents' and discriminated adolescents' experiences through a multidimensional and longitudinal approach.

Practical Implications: The findings stress the need for digital literacy education beyond basic functional skills, focusing on context-specific literacies. Emphasis on digital communication and information-navigation literacies can help teachers, youth workers, and caregivers protect vulnerable adolescents from cyberhate exposure.

Digital media have provided many opportunities for constructive self-expression and communication, but they also created an arena for expressing cyberhate – online hate speech (i.e., textual, visual, audio-visual) and aggression via information and communication technologies (ICTs) that is motivated by negative intergroup attitudes (Mondal et al., 2017). Cyberhate involves attacks directed at entire groups but also on individuals who possess (or are thought to possess by the aggressors) characteristics of the group, such as ethnicity, religion, sexual orientation, or gender (e.g., Chetty & Alathur, 2018; Jaron Bedrosova et al., 2024; Kansok-Dusche et al., 2022). Cyberhate can appear in private messages, public social media posts, online discussion comments, and extremist website content.

Cyberhate is increasingly prevalent online. A survey among adolescents (aged 11–17) in seven European countries showed that 21–59% had been exposed to cyberhate in the preceding year (Machackova et al., 2020). This exposure mainly occurs on social media or in online gaming contexts (Reichelmann et al., 2021; Waechter & Meschik, 2023). Understanding the factors that influence adolescents' cyberhate exposure is essential because adolescents are forming intergroup attitudes (Cortese, 2005) and are frequent internet users. Cyberhate exposure can negatively affect them and harm society. It is connected to lower well-being (Keipi et al., 2018), social trust (Näsi et al., 2015), higher anxiety, and depression (Cano et al., 2021). It also normalises hateful discourse (Ortiz, 2021), desensitises users (Soral et al., 2018), reduces prosocial behaviours toward targeted groups (Weber et al., 2020), and reinforces negative societal attitudes toward vulnerable groups.

Discriminated adolescents might be particularly vulnerable to extremist propaganda and cyberhate, with increased exposure compared to their peers (e.g., Bedrosova et al., 2023; Nienierza et al., 2021; Stoilova et al., 2021). To investigate this association, our study further examines the social compensation hypothesis of internet use (Valkenburg & Peter, 2011; Valkenburg et al., 2006), which suggests that online spaces benefit socially disadvantaged youth by offering an easily controllable space for self-presentation and interactions. Here, digital literacy plays a crucial role in helping adolescents critically assess the online content they encounter. However, the hypothesis has mostly been tested in relation to potentially beneficial social interactions, like online friendship and dating (e.g., Desjarlais & Willoughby, 2010; Toma, 2022). Less focus has been given to whether the social compensation mechanism can shield youth from negative experiences, such as cyberhate exposure. Addressing such negative online experiences is, however, crucial, because they can undermine the social benefits proposed by the hypothesis and

potentially exacerbate the effects of vulnerabilities rather than mitigate them. To address this gap, we explore how digital literacy can help discriminated youth mitigate cyberhate exposure, which can be viewed as another form of discrimination. Understanding the factors behind both intentional (i.e., active searching) and unintentional (i.e., accidental encounters) cyberhate exposure can guide more effective prevention strategies for this vulnerable group.

Six countries – Estonia, Finland, Germany, Italy, Poland, and Portugal – were selected to ensure a balanced representation of European adolescents from contexts with high, medium, and low rankings on the Digital Economy and Society Index (DESI; European Commission, 2018). Our focus is not country comparison; this selection ensures that diverse digital environments are represented, allowing for a broader understanding of the relationship between digital literacy and cyberhate exposure in Europe.

Intentional and unintentional cyberhate exposure

Intentional and unintentional cyberhate exposure are distinct experiences with different motivations and impacts on youth. While ample research addresses cyberhate exposure (Jaron Bedrosova et al., 2024), few studies have differentiated between these experiences (Keipi et al., 2017; L. Pauwels & Schils, 2016; L. J. R. Pauwels et al., 2018; Reichelmann et al., 2021). To our knowledge, only one cross-sectional study investigated the individual factors that differentiate them for adolescents (Bedrosova et al., 2023).

Intentional and unintentional cyberhate exposure overlap; those intentionally seeking it may also encounter it unintentionally, especially through algorithmic recommendations (Keipi et al., 2017). However, research indicates differences, because most youth are exposed unintentionally, while intentional exposure is less common (Bedrosova et al., 2023; Keipi et al., 2017; Reichelmann et al., 2021), potentially involving a specific group of youth more susceptible to hateful messages. Sensation-seeking, cyberhate perpetration, and proactive beliefs about violence were identified as risk factors for intentional searching among a representative sample of European adolescents (aged 12–16; Bedrosova et al., 2023). Similarly, L. Pauwels and Schils (2016) found a connection between intentional exposure and aggression, linking active intentional extremist online communication to offline political violence among youth aged 16 to 24. Another study with young adults (aged 15–31; L. J. R. Pauwels et al., 2018) found that active exposure is associated with the endorsement of political extremism. These findings suggest that intentional exposure involves youth more vulnerable to extremist messages and that is associated with problematic behaviours and aggression, highlighting the need to understand the factors that differentiate it from more common unintentional exposure.

Perceived discrimination and cyberhate exposure

Discrimination and cyberhate are both intergroup bias-related social risks. Discrimination is a biased behaviour. The term refers to inappropriate or unfair treatment of people due to their group membership (Dovidio et al., 2010), and it can manifest both online and offline (Keum et al., 2024). Online forms of discrimination can overlap with cyberhate victimisation (i.e., being mistreated or targeted online due to one's group identity; e.g., Gözrig et al., 2023; Weinstein et al., 2021). However,

discrimination is distinct from cyberhate exposure (Wypych & Bilewicz, 2024). Discrimination is based on one's own group characteristics, like race or ethnicity, whereas cyberhate exposure is not necessarily linked to one's group identity, because it can involve witnessing content that targets groups to which one does not belong. Further, cyberhate does not need to be directed at a specific individual. It can impact anyone exposed. Though discrimination and cyberhate exposure are distinct experiences and may not involve the same individuals, both phenomena are related (Wypych & Bilewicz, 2024). Youth with minority backgrounds report higher cyberhate exposure (Bedrosova et al., 2023; Pyżalski & Smith, 2022; Stoilova et al., 2021) and vicarious victimisation (i.e., cyberhate exposure with second-hand victimisation; Jaron Bedrosova et al., 2024) than their non-minority peers. However, when differentiating how discrimination relates to unintentional and intentional cyberhate exposure, there are consistent results only for the former.

To understand the link between discrimination and unintentional exposure, we should consider that discriminated youth might be more apt to recognise and report cyberhate exposure. While frequent exposure can desensitise the general public (Schmid et al., 2022; Soral et al., 2018), this might not apply to discriminated youth, who report higher sensitivity to hate speech (Cáceres-Zapatero et al., 2023). Interviews with LGBTQ+ youth (Setty, 2022) showed that cyberhate exposure exacerbates offline discrimination, causing emotional distress and worries about offline hate. As a result, their experiences and heightened concerns might make them less desensitised and more likely to recognise and report higher unintentional cyberhate exposure.

Inconsistent results exist for discrimination and intentional cyberhate exposure. On one hand, discriminated youth, with heightened sensitivity to hate, may avoid hate-filled places and not intentionally search for them, reducing intentional exposure. Consistent with this assumption, a study with German adolescents (aged 14–19; Nienierza et al., 2021) showed a link between discrimination experiences and exposure to online extremism – which is one manifestation of cyberhate – on ordinary online platforms (e.g., social media, video-sharing websites, blogs) but not on extremist websites. In other words, discriminated adolescents did not intentionally search for cyberhate on extremist websites where such content might be expected; however, they were exposed to it on other platforms, where it might have happened unintentionally. On the other hand, a positive cross-sectional association between discrimination and intentional exposure has also been found (Bedrosova et al., 2023), indicating that intentional searching for cyberhate can be part of coping strategies or a vicious circle of hate and retaliation (Cáceres-Zapatero et al., 2023; Wachs et al., 2020). Another explanation is that intentional cyberhate exposure might shape one's online presence and create vulnerabilities that could lead to further discrimination.

A causal investigation into the link between discrimination and un/intentional cyberhate exposure is still missing. We propose the following research question:

RQ1: What is the relationship between perceived discrimination and intentional or unintentional cyberhate exposure among adolescents over time?

Digital literacy and cyberhate exposure

Adolescents' online behaviours are significantly influenced by their digital literacy – an umbrella term that includes digital skills and knowledge. Digital skills are the functional part of digital literacy and they involve the practical abilities needed to use ICTs effectively. Digital knowledge refers to a critical understanding of how and why ICTs work and affect individuals and society (Helsper et al., 2020; Smahel et al., 2023).

Digital literacy is associated with more time spent online, greater platform use, and more online interaction, which all increases both online opportunities and risks (Haddon et al., 2020; Livingstone et al., 2023; Vissenberg et al., 2022). As such, it can play a dual role in cyberhate. While adolescents with higher digital skills reported higher cyberhate exposure (Bedrosova et al., 2023; Vandoninck et al., 2010), previous studies have not captured the critical knowledge component of digital literacy nor its multidimensionality. As a result, it remains unclear whether the specific dimensions of digital literacy can mitigate un/intentional cyberhate exposure. To address this gap, we followed a framework that encompassed five digital literacy dimensions (Helsper et al., 2020): (1) technical and operational literacy involves managing and operating ICTs, including the features of devices, platforms, and apps. (2) Information navigation and processing literacy refers to finding, selecting, and critically evaluating digital information. (3) Communication and interaction literacy includes using digital media to interact, build networks, and evaluate the effects of mediated communication. (4) Content creation and production literacy encompasses creating quality digital content, understanding its production, and recognizing its impact. And (5) Programming literacy reflects the ability to use a programming language.

Research shows that only some digital literacy dimensions might help avoid the harmful consequences of risky online experiences (Donoso et al., 2020; Sonck & de Haan, 2013). A recent review (Livingstone et al., 2023) highlighted that some dimensions can either decrease (i.e., information literacy) or increase (i.e., technical, communication literacy) adolescents' online risk involvement. For cyberhate, a qualitative study (Setty, 2022) showed that youth perceive functional technical responses (e.g., blocking) to cyberhate as insufficient without critical understanding and evaluation of the content. Therefore, on the one hand, digital literacy (i.e., its technical dimensions and functional skills related to online communication) can present a risk factor because it may increase the likelihood of unintentional cyberhate exposure by providing access to more online content. It can also contribute to intentionally accessing platforms where hate is shared. Such a risky role for functional digital skills has previously been found cross-sectionally for both types of exposure when compared to no exposure (Bedrosova et al., 2023). Digital literacy (i.e., including its critical knowledge and information evaluation dimensions) can have a protective role because it is connected to increased recognition and awareness of the harmful consequences of cyberhate. Thus, it can allow adolescents to defend themselves from additional unintentional cyberhate exposure by recognising it and then employing their functional skills (e.g., user blocking or content reporting). It may also reduce the inclination to search for such content intentionally. For instance, extremism-related digital literacy, including the recognition of extremist strategies, protected adolescents from intentionally accessing extremist sites, while general media literacy did not (Nienierza et al., 2021).

Therefore, adopting a multidimensional approach to digital literacy, we ask this research question:

RQ2: How do different digital literacy dimensions affect adolescents' un/intentional cyberhate exposure over time?

The mediating role of digital literacy

Digital literacy can play a significant role for discriminated adolescents. As discussed earlier, it can potentially facilitate access to hateful content while also enabling protection. Research shows that discriminated adolescents face a higher risk of cyberhate exposure, leading to additional negative impacts (e.g., Cano et al., 2021). Thus, it is crucial to understand how digital literacy influences the cyberhate experiences of this group.

Assuming that discrimination experiences manifest both online and offline (Görzig et al., 2023; Weinstein et al., 2021), the social compensation theory of internet use (Valkenburg & Peter, 2011; Valkenburg et al., 2006) proposes that socially disadvantaged youth can turn to online spaces to compensate for social exclusion and to foster new relationships and safer interactions. This is in line with research on vulnerable youth in six European countries that shows that perceived ethnic discrimination is linked to greater online civic engagement (De Coninck et al., 2024). The social compensation theory has been investigated further in various domains, including social disadvantage-social anxiety (Weidman et al., 2012), internalising symptoms, intercultural difficulties (Chen et al., 2022), and psychosocial vulnerabilities (Toma, 2022). It has also been suggested that discrimination experiences might prompt youth to develop higher digital literacy as a coping mechanism (De Coninck & d'Haenens, 2023; Mascheroni et al., 2022), though findings are inconsistent. In a study with European children (Mascheroni et al., 2022), no direct impact for discrimination on digital skills development was evident, but discrimination diminished the positive impacts of other personal and socio-cultural resources on digital skills development. However, this study focused only on digital skills, not critical knowledge, and it did not differentiate skills dimensions. In contrast, another study found that discriminated youth possessed higher programming skill and content-creation literacy than their non-discriminated peers, while communication and interaction literacies were higher among the latter (De Coninck et al., 2023). This highlights the complexity of the digital literacy role in this group. Yet, we still do not know if or how the development of digital literacy can reduce discriminated adolescents' cyberhate exposure – a possible additional manifestation of their discrimination experiences. While the social compensation theory suggests that increased digital literacy could reduce both types of cyberhate exposure, it is possible that higher literacy could also facilitate intentional cyberhate searches because it helps youth curate and control their online experiences and interactions according to their preferences (Smahel et al., 2023). Therefore, if discriminated youth intentionally search for cyberhate, higher digital literacy may facilitate it and, consequently, increase their unintentional cyberhate exposure.

To investigate these associations, we extend existing cross-sectional research with a longitudinal exploration, and we ask:

RQ3: How does the development of different digital literacy dimensions mediate the relationship between perceived discrimination and un/intentional cyberhate exposure over time?

The present study

This study contributes to the differentiation of intentional and unintentional cyberhate exposure, which may involve distinct adolescent groups and require tailored prevention strategies. We address the lack of causal explanations for factors that put vulnerable adolescents at risk of cyberhate exposure by focusing on perceived discrimination (related to origin, ethnicity, and religion) and digital literacy with a novel multidimensional approach. This approach highlights the importance of assessing both functional skills and critical knowledge in order to provide targeted recommendations for digital literacy education and online risk prevention. Using a robust longitudinal dataset from six countries, we aim to advance the social compensation hypothesis of internet use (Valkenburg & Peter, 2011; Valkenburg et al., 2006), which suggests that individuals may use the internet to compensate for offline disadvantages. By applying the hypothesis to the context of discrimination and cyberhate, we address an important but underexplored area and contribute to understanding how digital literacy can buffer against the online consequences of offline discrimination.

In the analysis, we control for time spent online, which affects youth's cyberhate exposure (Jaron Bedrosova et al., 2024), and for sociodemographic factors (i.e., age, gender, socio-economic status; SES).

Data and methods

We gathered data through a three-wave school-based survey of adolescents (aged 12–15 at the beginning, 14–17 at the end) in six European countries (Estonia, Finland, Germany, Italy, Poland, Portugal). The survey took place in 2021 (W1), 2022 (W2), and 2023 (W3) with 10,821 participants. Our focus is on adolescents who completed all of the waves ($N = 2,660$; Estonia: $n = 606$, Finland: $n = 441$, Germany: $n = 403$, Italy: $n = 351$, Poland: $n = 261$, Portugal: $n = 598$). Data were collected in collaboration with secondary schools (ISCED-2, ISCED-3) using convenience sampling to ensure participant diversity. For details about the sampling and data collection, see Machackova et al. (2024). After each wave, we merged country datasets, checked data quality, and recoded low-quality data and response sets as missing values. Respondents with over 70% of missing values were excluded.

The survey was translated into the official languages of the participating countries. Data were collected in class, onsite or online, with researchers present physically or digitally. Informed consent was obtained from participants and their legal guardians per national regulations. After IBR approval at the project coordinator's university (KU Leuven), country partners secured ethical approval from relevant national authorities (e.g., Federal Ministries, university committees; see Waechter et al., 2023 for details).

Measures

All items were presented consistently across all waves. For specific wording, refer to the data dictionary (Machackova et al., 2024).

Intentional and unintentional cyberhate exposure

The measurement included a brief definition of cyberhate—*content that attacks certain groups or individuals (e.g., because of their skin colour, religion, nationality, gender, or sexuality), which could be, for example, Muslims, migrants, Jews, Roma, etc. This could be in the form of hateful, degrading, or racist messages, comments, images, or videos*) and asked if participants had seen it (0 = no, 1 = yes). Follow-up questions for those exposed asked about the frequency of the intentional and unintentional exposure (1 = never, 6 = daily or almost daily).

Digital literacy

We used the youth Digital Skills Indicator, a 27-item scale with five digital literacy dimensions, including digital skills and digital knowledge (Helsper et al., 2020): (1) technical and operational skills (five items); (2) programming skill (one item); (3) information navigation and processing literacy (five skills, two knowledge items); (4) communication and interaction literacy (five skills, two knowledge items); and (5) content creation and production literacy (five skills, two knowledge items). Answer options for digital skills items ranged from 1 (*not at all true of me*) to 5 (*very true of me*); and for digital knowledge items options included 1 (*definitely not true*), 2 (*definitely true*), and 3 (*I am not sure*), and they were recoded to indicate 0=*incorrect* or 1=*correct knowledge* for each item. For each dimension, except programming, we calculated the proportion of digital skills and knowledge items for the analyses (see Helsper et al., 2020; Machackova et al., 2024). The scale was internationally validated and factor invariance tests were done during piloting to ensure that the factor loadings were similar across countries (Helsper et al., 2020). All dimensions had high reliability (Cronbach's $\alpha > .70$) in the current sample in all of the waves.

Perceived discrimination

This measurement was adapted from Global and EU Kids Online surveys Global Kids Online (GKO, 2016; Zlamal et al., 2020) and asked about the frequency of everyday discrimination due to origin, skin colour, or religion (1=*never*, 6=*daily or almost daily*).

Control variables

We controlled for age, gender (boy/girl/other), time spent online (1 = *little or no time online during a regular weekday*, 9 = *about 7 hours or more online*), and subjective household financial situation (SES; 1 = *we struggle to get by*, 5 = *we live very well*).

Analysis

We conducted a cross-lagged panel structural equation model (see Figure 1) to investigate whether perceived discrimination prospectively predicted digital skills and literacy, and whether these, in turn, predicted un/intentional cyberhate exposure. We controlled for age, gender, SES, and time spent online at W3. To summarise, we estimated (1) cross-lagged associations between perceived discrimination, digital skills and literacy, and un/intentional cyberhate exposure at W1 with the same variables at W2, and (2) cross-lagged associations between perceived discrimination, digital skills and literacy, and un/

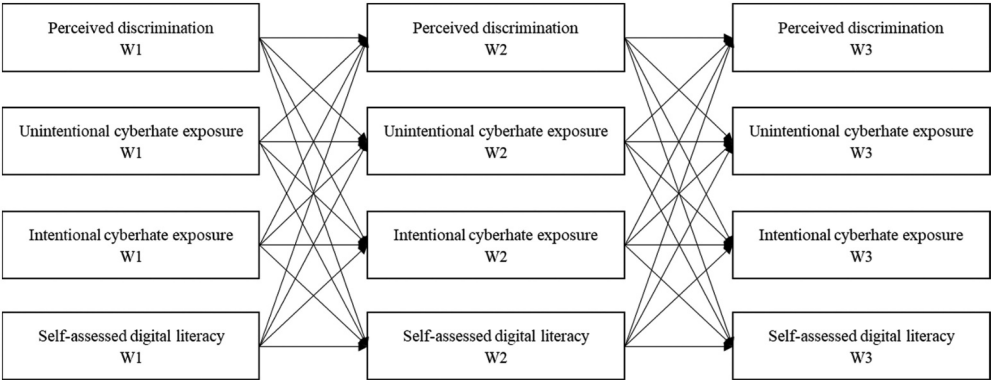


Figure 1. Theoretical model.

intentional cyberhate exposure at W2 with the same variables at W3. Due to item-skipping by some participants, the analysis covers 592 participants with complete data. See [Table 1](#) for sample characteristics.

All analyses were conducted using SAS version 9.4. Model fit for the cross-lagged analysis was evaluated using state-of-the-art guidelines. We used maximum likelihood estimation with standard errors. Standardised results are presented below.

The attrition rates were 34.3% from W1 to W2, 39.6% from W2 to W3, and 54.8% cumulatively from W1 to W3. To assess attrition effects on the sample, we tested differences in key variables (i.e., age, gender, SES, internet use, digital literacy) across waves. These tests revealed minimal differences in the sample due to attrition. For gender, the Cramer’s *V* values ranged between .029 and .034, indicating negligible differences (threshold for small effect *V* = 0.1). For other variables (i.e., age, SES, internet use, digital literacy), the Cohen’s *d* values ranged from $-.153$ to $.085$, underscoring that any observed variations were of a small magnitude (threshold for small effect *d* = 0.2).

Results

Looking at the results of the cross-lagged panel analysis ([Table 2](#)), the proposed model with paths running between perceived discrimination, digital skills and literacy, and un/intentional cyberhate exposure across three waves yielded a good fit with the data (RMSEA=.062; CFI = .915; GFI = .930; SRMR = .081; $\chi^2 = 532.807$; *df* = 185; *p* < .001). For model parsimony, we re-ran the analysis with non-significant paths (*p* > .05) removed. This yielded an improved fit (RMSEA = .049; CFI = .931; GFI = .935; SRMR = .065; $\chi^2 = 279.15$; *df* = 142; *p* < .001).

The direct effects indicate that, at W2, perceived discrimination at W1 was positively associated with greater intentional ($\beta=.136$, *p* < .001) and unintentional ($\beta = .088$, *p* < .05) exposure. Regarding digital skills and literacy, we observed significant positive cross-lagged effects between technical and operational skills ($\beta=.109$, *p* < .05) and programming skills ($\beta = .105$, *p* < .001) at W1 and intentional exposure at W2. A negative cross-lagged link was found between communication and interaction literacy and intentional

Table 1. Descriptive overview of the sample by country ($N = 592$).

In %	Estonia	Finland	Germany	Italy	Poland	Portugal	Total
Gender (W3)							
Male	45.9	44.4	48.6	59.3	40.2	45.5	47.3
Female	51.5	53.6	48.4	38.5	54.4	54.0	50.5
Other	2.6	2.1	3.0	2.3	5.4	0.5	2.2
Mean scores (SE in brackets)	Estonia	Finland	Germany	Italy	Poland	Portugal	Total
Age (W3)	16.29 (1.15)	16.19 (0.97)	15.96 (1.16)	16.69 (1.04)	16.14 (1.65)	16.45 (1.27)	16.29 (1.20)
SES (W3)	3.66 (0.77)	3.74 (0.71)	3.96 (0.77)	3.71 (0.66)	3.97 (0.71)	3.66 (0.60)	3.78 (0.73)
Time spent online (W3)	6.08 (1.93)	6.64 (1.54)	5.88 (1.88)	6.03 (1.66)	6.03 (1.71)	5.60 (1.83)	6.04 (1.75)
Intentional exposure							
W1	1.63 (1.26)	1.42 (1.02)	1.44 (0.79)	1.60 (1.09)	2.01 (1.44)	1.66 (1.12)	1.58 (1.06)
W2	1.79 (1.39)	1.50 (1.13)	1.52 (1.04)	1.68 (1.15)	2.09 (1.59)	1.71 (1.28)	1.61 (1.15)
W3	1.69 (1.33)	1.40 (1.00)	1.49 (1.07)	1.71 (1.25)	2.02 (1.51)	1.68 (1.18)	1.63 (1.11)
Unintentional exposure							
W1	2.52 (1.61)	2.24 (1.60)	2.78 (1.56)	2.64 (1.50)	2.77 (1.53)	3.10 (1.45)	2.65 (1.57)
W2	2.63 (1.56)	2.13 (1.46)	2.74 (1.41)	2.60 (1.53)	2.89 (1.54)	2.97 (1.34)	2.66 (1.40)
W3	2.63 (1.54)	1.99 (1.44)	2.74 (1.32)	2.61 (1.42)	2.68 (1.61)	2.89 (1.27)	2.69 (1.44)
Perceived discrimination							
W1	1.56 (1.01)	1.41 (0.95)	1.36 (0.83)	1.19 (0.62)	1.66 (1.22)	1.23 (0.67)	1.32 (0.85)
W2	1.60 (1.14)	1.45 (1.03)	1.53 (1.01)	1.28 (0.80)	1.90 (1.41)	1.26 (0.77)	1.44 (0.96)
W3	1.70 (1.22)	1.44 (1.02)	1.61 (1.05)	1.30 (0.86)	1.82 (1.27)	1.26 (0.76)	1.50 (1.11)
Technical/operational skills							
W1	0.58 (0.31)	0.58 (0.31)	0.51 (0.29)	0.57 (0.28)	0.50 (0.30)	0.54 (0.32)	0.56 (0.30)
W2	0.64 (0.34)	0.62 (0.32)	0.59 (0.30)	0.60 (0.29)	0.54 (0.32)	0.62 (0.32)	0.60 (0.30)
W3	0.67 (0.34)	0.64 (0.32)	0.59 (0.32)	0.63 (0.29)	0.60 (0.32)	0.65 (0.32)	0.61 (0.31)
Programming skill							
W1	0.04 (0.19)	0.06 (0.24)	0.07 (0.26)	0.03 (0.16)	0.13 (0.33)	0.03 (0.16)	0.05 (0.21)
W2	0.06 (0.24)	0.10 (0.31)	0.08 (0.27)	0.04 (0.20)	0.11 (0.31)	0.04 (0.20)	0.08 (0.25)
W3	0.07 (0.25)	0.12 (0.32)	0.09 (0.29)	0.11 (0.31)	0.09 (0.29)	0.07 (0.25)	0.10 (0.23)
Information navigation/processing literacy							
W1	0.36 (0.26)	0.45 (0.28)	0.42 (0.26)	0.39 (0.25)	0.39 (0.26)	0.37 (0.26)	0.39 (0.25)
W2	0.38 (0.28)	0.48 (0.28)	0.48 (0.27)	0.40 (0.26)	0.42 (0.26)	0.41 (0.26)	0.43 (0.27)
W3	0.39 (0.28)	0.48 (0.30)	0.49 (0.27)	0.42 (0.26)	0.45 (0.31)	0.44 (0.28)	0.43 (0.28)
Communication/ interaction literacy							
W1	0.56 (0.25)	0.64 (0.24)	0.55 (0.25)	0.56 (0.21)	0.52 (0.24)	0.57 (0.26)	0.58 (0.22)
W2	0.57 (0.28)	0.63 (0.26)	0.58 (0.25)	0.55 (0.23)	0.54 (0.24)	0.61 (0.25)	0.56 (0.24)
W3	0.58 (0.28)	0.63 (0.26)	0.61 (0.25)	0.56 (0.24)	0.57 (0.26)	0.66 (0.24)	0.60 (0.25)

(Continued)

Table 1. (Continued).

In %	Estonia	Finland	Germany	Italy	Poland	Portugal	Total
Content creation/production literacy							
W1	0.40 (0.27)	0.51 (0.30)	0.44 (0.28)	0.44 (0.24)	0.41 (0.27)	0.43 (0.28)	0.45 (0.26)
W2	0.42 (0.30)	0.49 (0.28)	0.49 (0.28)	0.44 (0.26)	0.43 (0.27)	0.48 (0.27)	0.46 (0.28)
W3	0.45 (0.31)	0.51 (0.31)	0.50 (0.29)	0.46 (0.24)	0.50 (0.28)	0.50 (0.28)	0.48 (0.28)
N	89	77	125	101	49	88	529

Table 2. Cross-lagged panel analysis ($n = 324$).

	Perceived discrimination W2	Perceived discrimination W3	Inten. exposure W2	Unint. exposure W2	Intent. exposure W3	Unint. exposure W3
Direct effects						
Perceived discrimination						
W1	.40***	-	.136***	.088*	-	-
W2	-	.51***	-	-	.080*	ns
Technical/operational skills						
W1	ns	-	.109*	ns	-	-
W2	-	ns	-	-	ns	.119***
Programming skill						
W1	ns	-	.105***	ns	-	-
W2	-	ns	-	-	.079*	ns
Information navigation/ processing literacy						
W1	ns	-	ns	ns	-	-
W2	-	ns	-	-	-.084*	-.112***
Communication/interaction literacy						
W1	ns	-	-.089*	ns	-	-
W2	-	ns	-	-	-.075*	ns
Content creation/production literacy						
W1	ns	-	ns	ns	-	-
W2	-	ns	-	-	ns	ns
Indirect effects						
Perceived discrimination W1					.099***	.076**
Technical/operational skills W1					.054*	.073*
Programming skill W1					.067***	ns
Information navigation/ processing literacy W1					ns	-.071*
Communication/interaction literacy W1					-.061*	ns
Content creation/production literacy W1					ns	ns

* $p < .05$; ** $p < .01$; *** $p < .001$. Standardised estimates are presented. ns=not significant ($p > .05$). Analyses control for gender, SES, time spent online, age.

exposure ($\beta = -.089$, $p < .05$). No significant associations were found between digital skills and literacy and unintentional exposure.

At W3, perceived discrimination at W2 was again associated with greater intentional exposure ($\beta = .080$, $p < .05$) but not with greater unintentional exposure. For the link between digital skills and literacy and cyberhate exposure, we noted a positive link between programming at W2 and intentional ($\beta = .079$, $p < .05$) and unintentional

exposure ($\beta = .119, p < .001$). Information navigation ($\beta = -.084, p < .05$) and communication and interaction literacy ($\beta = -.075, p < .05$) were linked to lower intentional exposure. Information navigation literacy was also linked to decreased unintentional exposure ($\beta = -.112, p < .001$) at this time.

We observed several significant associations regarding the indirect effects of perceived discrimination and digital skills and literacy at W1 on cyberhate exposure at W3. Perceived discrimination at W1 was indirectly associated with greater intentional ($\beta = .099, p < .001$) and unintentional ($\beta = .076, p < .001$) exposure at W3. Technical and operational skills at W1 were indirectly linked to greater intentional ($\beta = .054, p < .05$) and unintentional ($\beta = .073, p < .05$) exposure at W3. Information navigation literacy was linked to lower unintentional exposure ($\beta = -.071, p < .05$), while communication and interaction literacy was linked to lower intentional exposure ($\beta = -.061, p < .05$). Full results of the cross-lagged analysis are available in the supplementary material here: <https://osf.io/wexms>.

Discussion

Cyberhate exposure can be intentional or unintentional, necessitating a distinction to be made between these experiences because they may involve different adolescent groups and different underlying psychological mechanisms. We focused on two differentiating factors – perceived discrimination (due to origin, ethnicity, or religion) and digital literacy. The primary goal was to determine whether perceived discrimination predicts un/intentional cyberhate exposure; while the second goal explored how digital literacy dimensions impact this relationship.

Perceived discrimination and cyberhate exposure

When answering RQ1, we saw that perceived discrimination increased both types of cyberhate exposure. Discriminated adolescents are particularly vulnerable, because perceived discrimination leads to unintentional cyberhate exposure. Here, several types of experience must be considered. First, some of the discriminated adolescents might be exposed to cyberhate that targets their own groups (i.e., ethnic, national, or religious). In other words, their discrimination experience can manifest in the online context and overlap with cyberhate victimisation. Consequently, these adolescents may report higher unintentional cyberhate exposure, which is a related experience (Jaron Bedrosova et al., 2024). Indeed, a connection between direct cyberhate victimisation and vicarious cyberhate exposure has been established (English et al., 2020). A similar mechanism may apply to those who experience offline discrimination, because research shows that discriminated adolescents encounter discrimination and hate in various situations, transcending online and offline contexts (Görzig et al., 2023; Weinstein et al., 2021). Second, discriminated adolescents might be exposed to cyberhate that targets other groups. Cyberhate exposure, as we measured it, can also involve incidents that target people due to their gender or sexual orientation – exposure to which is prevalent among youth (e.g., Reichelmann et al., 2021). Discriminated adolescents might be more sensitive toward cyberhate in general (Cáceres-Zapatero et al., 2023). Based on their own experiences with discrimination, they might be better able to recognise biased and unfair content and attacks on other groups, and thus report higher unintentional cyberhate exposure.

Perceived discrimination also leads to higher intentional cyberhate exposure, extending previous cross-sectional findings (Bedrosova et al., 2023). We also contribute to research on online risky behaviours (Bosman et al., 2015; Livingstone et al., 2011), which indicates that discriminated youth are more prone to seek harmful content, by showing that this includes cyberhate. We propose two possible explanations. First, intentional cyberhate seeking may be a maladaptive coping strategy and a precursor to perpetration – which aligns with the ‘vicious circle of violence’ observed cross-sectionally, where bystanders and victims may become perpetrators (Wachs et al., 2021). In other words, discriminated adolescents might seek hateful content or interact with perpetrators, potentially becoming perpetrators themselves. A similar pattern is seen in online extremism, where exposure and active search correlate with political violence (L. Pauwels & Schils, 2016). However, further longitudinal research is needed to explore the link between intentional exposure and perpetration.

Alternatively, intentional cyberhate exposure may serve as an adaptive coping strategy. Discriminated adolescents may seek cyberhate to find information, connect with others with similar experiences, find support, or engage in counter-speech. Similar coping strategies have been studied in offline racism (Brondolo et al., 2009). Adolescents might also use online platforms to validate their experiences or empower community counter-action (Jones et al., 2020). Future studies should qualitatively explore the motivations behind intentional cyberhate exposure, because both explanations may apply to different adolescents.

The role of digital skills and literacy

Our findings confirmed that various digital literacy dimensions influence cyberhate exposure differently (RQ2). Technical and operational skills (i.e., the ability to operate ICTs and the technical affordance of devices, platforms and apps) led to higher intentional exposure in subsequent years, while programming skill (i.e., the ability to use a programming language) resulted in higher intentional and unintentional exposure. These results align with research that suggests that increased digital literacy correlates with greater online risks and exposure to harmful content (Donoso et al., 2020; Haddon et al., 2020), because higher digital literacy often leads to broader online engagement and more exploratory behaviours in diverse online environments (Vissenberg et al., 2023). Specifically, our findings suggest that technical, operational, and programming skills can indeed be risk factors for cyberhate exposure when not complemented with training in ethical and critical thinking. Technical skills alone do not provide the necessary ethical frameworks to navigate digital spaces safely. Ethical blind spots, where individuals lack moral reasoning to recognise and avoid harmful content, can exacerbate the risks associated with digital literacy (Haddon et al., 2020). This underscores the importance of integrating ethical education into technical training, as emphasised by Donoso et al. (2020).

In contrast, our findings suggest a protective role for other digital literacy dimensions. Communication and interaction literacy (i.e., the ability to use different media to interact with others and critically evaluate the impact of interpersonal communication on others) decreased intentional exposure, while information navigation literacy (i.e., the ability to find, select and critically evaluate online information) decreased unintentional exposure.

Adolescents skilled in information navigation can better avoid unwanted content, like cyberhate, and platforms where this content is disseminated. This aligns with research highlighting critical evaluation skills in avoiding harmful online content (Donoso et al., 2020; Livingstone et al., 2018). Interestingly, communication and interaction literacy safeguards adolescents from intentional cyberhate exposure because it fosters a better understanding of the harm associated with interacting with cyberhate perpetrators. Our measurements highlight that a key aspect of this literacy includes recognising cyberhate and negative content that targets individuals or groups, and knowing how to report it. These results underscore the need for including education about online risks and coping strategies in digital literacy courses, alongside technical, operational, and programming skills development.

We found similar patterns for adolescents who report perceived discrimination (RQ3). High initial levels of technical, operational, and programming skills were risk factors for un/intentional cyberhate exposure. These skills did not reduce perceived discrimination but they were linked to higher cyberhate exposure, especially for youth with heightened discrimination experiences. Conversely, information navigation and communication literacy had protective effects. Adolescents with higher initial levels of these literacies, despite experiencing higher discrimination, reported decreases in intentional (i.e., adolescents with higher communication and interaction literacy) and unintentional (i.e., adolescents with higher information navigation literacy) cyberhate exposure. This reinforces our argument that reports of perceived discrimination and cyberhate exposure do not necessarily refer to the same incidents.

Our findings offer important insights for the social compensation hypothesis of internet use (Valkenburg & Peter, 2011; Valkenburg et al., 2006). While the hypothesis suggests that discrimination leads to the development of digital literacy as a coping mechanism, our study reveals a more complex relationship. Adolescents who face higher discrimination may develop greater digital literacy, but this does not necessarily reduce cyberhate exposure. Instead, digital literacy dimensions – which constitute only the functional component and not critical knowledge – are associated with increased risks of un/intentional cyberhate exposure. This challenges the traditional understanding of the social compensation hypothesis and suggests that higher digital literacy may not always serve as a protective factor. It highlights the need for a more nuanced view of digital literacy, where not all skills equally contribute to positive online experiences. Moreover, discriminated adolescents may lack adequate support in developing critical digital literacy, which limits their ability to navigate online environments safely. Their social disadvantage might translate into barriers to accessing resources that foster critical thinking, ethical understanding, and information literacy. Consequently, our findings imply that, for the social compensation hypothesis to be effectively applied, interventions must prioritise the cultivation of critical thinking, mainly in the areas of information navigation, processing, communication, and interaction literacy, together with functional skills. By doing so, we can better equip vulnerable adolescents to navigate online spaces safely and mitigate potential harms. The direct effects of digital literacy on cyberhate exposure also indicate that these educational efforts would benefit all adolescents, regardless of discrimination experiences.

Limitations and future directions

Our study has several limitations. Reliance on self-reported data presents potential biases because social desirability could influence responses. Further, our measurement of perceived discrimination does not capture participants' actual socio-demographic backgrounds or differentiate among the reasons for discrimination. Given that our measurement of perceived discrimination was based on everyday experiences, there is a potential overlap between online and offline contexts, which complicates the analysis because increases in perceived discrimination experiences could include increased cyberhate exposure. Future research should aim to distinguish online/offline discrimination experiences more precisely to understand their specific contributions to cyberhate exposure. We also faced challenges in clearly disentangling the mediation effects of perceived discrimination and digital literacy on cyberhate exposure, necessitating further research to isolate these effects to understand their individual and combined impacts. Further, we did not explore the psychological harm associated with cyberhate exposure. Previous research indicates that higher digital literacy may mitigate negative outcomes from online risks (van Deursen, 2020). Future studies should investigate these outcomes and examine how different digital literacy dimensions influence them. Lastly, the motives behind intentional cyberhate exposure were not inquired about and should be examined in future studies to develop more effective interventions and support systems.

Practical implications

Our results suggest several practical implications. Digital literacy curricula in schools and youth programs should extend beyond functional skills to include critical information and communication literacy. This holistic approach better equips adolescents to navigate digital spaces safely and ethically. Targeted interventions for discriminated adolescents, focusing on critical thinking and information navigation literacy, are crucial due to their heightened vulnerability to cyberhate. Ongoing research is necessary as digital literacy and online behaviours evolve. Longitudinal studies can provide deeper insights into the long-term effects of digital literacy on cyberhate exposure and refine educational strategies.

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Data availability statement

The data is open-access and available in an online repository: <https://doi.org/10.17632/c66jczxfjc.4>.

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