



# The Swiss cheese model of social cues: a theoretical perspective on the role of social context in shaping social media's effect on adolescent well-being

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## Abstract

Media effects research has observed significant diversity in the effects of social media on adolescent well-being, with outcomes ranging from positive to negative and, in some cases, neutral effects. In an effort to comprehend and elucidate this diversity, we have formulated The Swiss Cheese Model of Social Cues, a theoretical framework that systematically categorizes potential sources contributing to these variations. This dynamic model encompasses the complex layers of social cues present within platforms, the social environment, and individual (neuro)susceptibility, collectively shaping how social media influences the well-being of adolescents. The primary goal of this model is to enhance research by concurrently considering a broader range of individual difference factors, providing a comprehensive framework for investigations into the complex interplay of social context in social media effects.

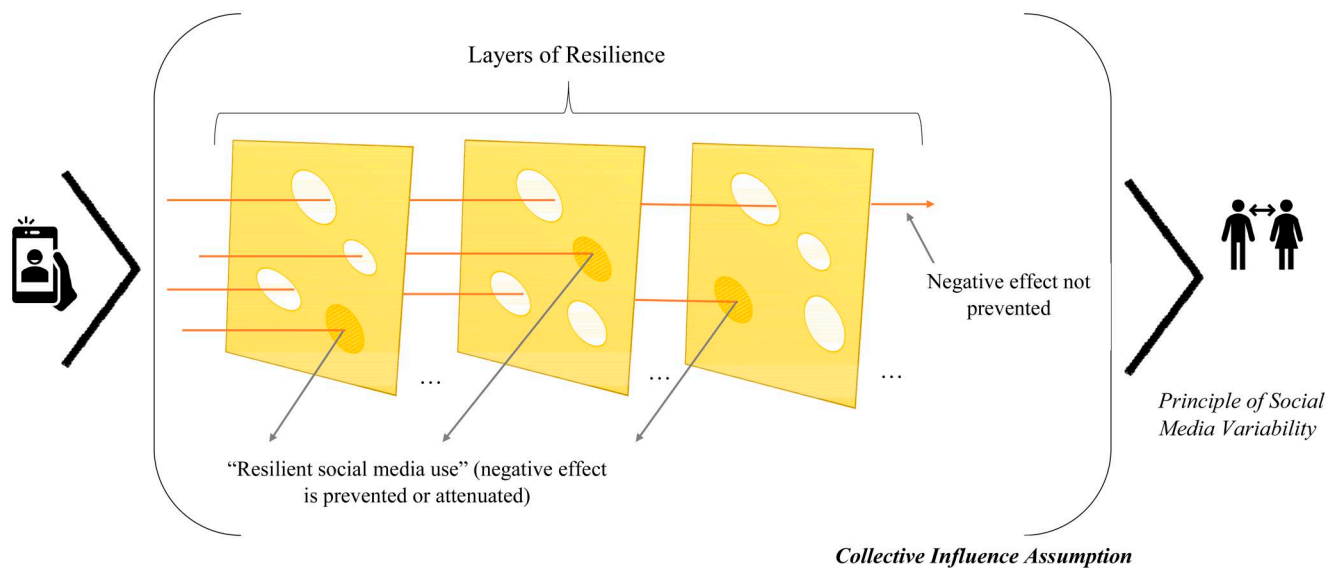
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Social media have become a ubiquitous part of adolescents' lives. Social media provide adolescents with endless opportunities for exploration, connection, and self-expression as well as constant access to quantifiable social rewards and feedback in the forms of likes, followers, and comments. These unique features of social media complement the physical, neurobiological, and socio-emotional changes that characterize adolescence, which intensify their sensitivity to social information (Blakemore & Mills, 2014). Not surprisingly, then, this era of constant connectivity has prompted numerous voices in the public sphere to proclaim social media's influence on youth's psychosocial well-being. The research, however, has produced mixed results at best. While some studies support the claim of negative effects (e.g., Twenge et al., 2018), others urge nuance (e.g., Orben & Przybylski, 2019). The research seems at an impasse with scholars calling into question both the empirical and theoretical claims on the role of social media in adolescent well-being and development.

In an attempt to resolve this impasse in the literature, the current manuscript presents a theoretical framework that reestablishes the fundamental "social" aspect into the study of social media effects. In fact, social media use is seldom disconnected from the social context; instead, it is influenced, shaped, and sustained by complex social dynamics and an individual's attunement to those dynamics.<sup>1</sup> This perspective is especially important for our understanding of adolescents' social media use, given the significance of social cues—cues from the social environment that convey information about social norms, self-perception in relation to

others, and how to navigate the social world—during this developmental period (Blakemore & Mills, 2014). A prominent feature motivating adolescents to use social media is its instant gratification of both social and emotional needs, such as those involved in identity development and relationship formation including self-expression, validation from peers, and a sense of belonging (Deci & Ryan, 2012).

However, contradictory research findings reveal that social media can both enhance the lives of some users in certain situations (e.g., fostering social connectedness) and pose challenges for others (e.g., inducing stress or feelings of exclusion), suggesting that there is variability in how social media affect users' mental well-being (Principle of Social Media Variability). We propose that by exploring the complex interplay of various social cues, we can identify the specific layers of resilience that either protect adolescents or contribute to challenges in their social media use. Resilience is defined as one's ability to bounce back from negative social media experiences and to maintain or quickly regain mental and emotional strength. Drawing on the Swiss Cheese Model (Figure 1), we argue that overlapping layers of personal and contextual factors, along with enduring and temporal social influences, serve to either protect against or contribute to challenges in social media use, determining whether adolescents are resilient or may encounter difficulties, depending on the unique combination of different resilience factors. By incorporating the inherent social aspect into our understanding of social media effects, we can also strengthen the endurance of the Swiss Cheese Model. This approach allows us to transcend particular technological advancements and industry



**Figure 1.** The Swiss Cheese Model of social cues.

*Note.* Resilience is embedded within different layers of social cues: social cues within the social media platforms, social dynamics in the immediate environment, and trait-level sensitivities to social cues within the individual. These layers are nested structures, each contributing to the overall impact, though not all layers are necessary for an effect to manifest.

trends (e.g., new apps) and instead prioritize examining the social dynamics by which social media are utilized.

### The inherent social dynamics of social media use

Adolescence is a complex developmental stage marked by significant physical, behavioral, and social changes (Blakemore & Mills, 2014). During this period, key developmental tasks include forming an identity and pursuing autonomy, while also forming affiliations and seeking acceptance from peers (Blakemore & Mills, 2014). Social media serve as effective tools to address (certain aspects of) these developmental tasks by fostering identity development and facilitating relationship formation (Throuvala et al., 2019). The distinct characteristics of social media, such as asynchronicity, increased control, and the quantification of social interactions (e.g., likes, views, followers), have profoundly influenced adolescent development and peer relationships (Nesi et al., 2018). For one, these platforms amplified the immediacy and frequency of interactions among adolescents and their peers—allowing adolescents instant social interactive gratification. The positive emotions, rewards, and benefits derived from social interactions such as connecting with others, receiving validation, support, or feedback, and experiencing a sense of belonging or social connectedness can thereby foster positive well-being and self-esteem. At the same time, the instant gratification of social needs may contribute to increased reassurance-seeking, a continued reliance on others for validating one's identity and self-worth, and increased pressures for relationship maintenance and accessibility (Nesi et al., 2018).

These important drawbacks hold particular relevance for adolescents who become more attuned to social cues due to a restructuring of the social brain around puberty (Blakemore & Mills, 2014) and are still in the process of developing executive functioning skills (i.e., inhibitory control) (Berthelsen et al., 2017). Given that the evaluation, representation, and

processing of self-concept information are fundamentally social processes (Blakemore & Mills, 2014), and social media platforms provide avenues to access such information, adolescents' involvement with social media is inherently driven and shaped by social dynamics (Nesi et al., 2018).

Social media are defined as “computer-mediated communication channels that allow users to engage in social interaction with broad and narrow audiences in real time or asynchronously” (Bayer et al., 2020, 316). At the same time, the literature has often conflated social media with specific platforms (e.g., TikTok, Instagram, or Facebook; Masur et al., 2022) or takes an affordance-approach where social media are defined by their general characteristics (e.g., interactivity, (a)synchronicity). A valuable approach to understanding social media involves exploring the motivations that drive users to engage with these platforms, akin to adopting a tool kit approach (Bayer et al., 2020). Individuals utilize a specific set of features to achieve diverse objectives, whether it is active use for self-presentation or entertainment-seeking, or more passive use like browsing content without active interaction. Additionally, building on the recent Personal Social Media Ecosystem Framework (PSMEF; Carter et al., 2023), social media may best be considered a user-centric digital environment made up of individual yet interconnected digital spaces (e.g., in-app pages), which are embedded within a broader ecology (e.g., operating systems, the Internet, offline contexts).

These perspectives share a common understanding that social media should be viewed holistically, acknowledging the complex, layered interactions within an individual's ecosystem that shape their social media experiences and, in turn, impact their development and well-being. With our model, we aim to specifically incorporate the intricate interplay of social context in adolescents' social media use to identify specific layers of resilience that either protect against or contribute to challenges.

## The Swiss Cheese Model of social cues

Our aim to incorporate social context in social media use is not a novel concept. A decade ago, the differential susceptibility model of media effects proposed that social contexts, such as peer norms, can amplify or mitigate the effects of media (Valkenburg & Peter, 2013). Similarly, the resonance-hypothesis found in media theories such as cultivation theory (Shrum, 2017), assumes that certain messages resonate more with individuals based on their social reality and interactions. More recently, Masur et al. (2022) advocated for a situational perspective by distinguishing between personal (e.g., traits, attitudes) and environmental factors (e.g., culture, norms) as contextual elements influencing the relationship between social media and well-being. Despite the strengths of these perspectives in accounting for specific types of social cues in the observed effects, there remains a significant oversight in both empirical and theoretical approaches regarding a systematic understanding of how different types of social cues—encompassing individual, social network, and channel-specific factors—intersect and collectively shape social media use and its effects on youth outcomes.

We propose a conceptual framework that views social context as a series of nested layers of resilience, which either shield adolescents or contribute to challenges in their social media use (see Figure 1). Resilience against negative social media effects depends on a complex interaction of social cues across multiple layers: those within the social media platforms themselves, the social dynamics of the immediate environment, and individual trait-level sensitivities to these cues. These layers create a nested structure, each influencing the overall impact, although not all layers need to be present for an effect to manifest.

The Swiss Cheese Model (Reason, 2000) originally illustrates how multiple layers of defense, each with potential weaknesses (visualized as holes), work together to prevent failures or challenges. An adverse outcome occurs when the holes in these layers align, allowing a problem to pass through all defenses despite the system's overall safety measures. Similarly, we argue that various layers of resilience (represented as slices) intersect to mitigate or prevent negative social media effects. In this model, resilient social media use is depicted as arrows bouncing off the layers, symbolizing adolescents' ability to navigate and counteract negative experiences. We assume that the strength of the negative effect is greater when the holes in all layers align, allowing harmful experiences to penetrate the defenses. Conversely, these effects can be prevented (when there are no holes) or attenuated (when there are only a few holes). Each layer represents different levels of social cues—such as those within social media platforms, the immediate environment, and individual sensitivities—that collectively influence how users perceive and respond to their social media experiences and thus their well-being.

Importantly, during adolescence, a critical developmental stage during which biological and social changes occur, young users may have fewer layers of resilience or more holes (i.e., vulnerabilities), making them more susceptible to the negative effects of social media. It is important to recognize that these layers of resilience coexist simultaneously, rather than operating sequentially, leading to variations in how individuals experience and respond to social media at different times. For example, a highly socially sensitive adolescent may be more affected by an idealized selfie with many likes during moments of social exclusion, while a well-accepted adolescent with

lower sensitivity to social cues might perceive the same selfie differently, potentially disregarding or opposing such content.

## Social cues within social media platforms

We first discuss the types of social cues present within social media platforms (e.g., likes, anticipation, and social norms) that play a role in shaping users' perceptions and responses to their online experiences. Building and expanding upon prior work aimed at establishing contextual stability in social media effects, we differentiate between social media elements (i.e., the profile, the stream, and the connection) and focus on the social cues present within those elements. Defining social media based on its apparent and intuitive elements aligns with the way users perceive it. Therefore, it may better grasp the (social) expectations, schemas, scripts, and goals related to different features of social media. This definition becomes particularly relevant in the context of our model, where we aim to explore how youth can effectively use social media to satisfy their needs in an adaptive manner.

### The profile

First, one of the most apparent and easily recognizable features of social media is the profile. It serves as a digital representation of the user, allowing them to share information about themselves in a personalized space (Bayer et al., 2020). For adolescents, in particular, the profile is a central focus, as they invest significant time in crafting and managing their online persona. The profile on social media platforms serves as the primary medium through which they can express their persona and how they are perceived by others. In line with self-determination (Deci & Ryan, 2012), adolescents' extensive engagement with social media can be attributed to its capacity to (promptly) satisfy their self-presentation and identity development needs. Social media platforms provide a space for adolescents to explore and construct their identities online, engaging in a process of continual self-reflection and reconstruction (Subrahmanyam & Šmahel, 2011). Friends and peers play a significant role in this process, acting as mirrors as adolescents experiment with and reflect on different aspects of their selves (i.e., the looking-glass self theory; Cooley, 1902). The highly visible and quantifiable peer feedback on social media platforms makes the anticipation of social rewards (e.g., likes, positive comments, traction) salient and serves as a crucial social cue that shapes adolescents' decisions regarding self-presentation (Subrahmanyam & Šmahel, 2011).

The anticipation of social rewards is intricately connected to norm perceptions and the imagined audience for each social media post. As evidenced by norm literature, human behavior is influenced by both descriptive norms (what others are doing) and injunctive norms (what others approve of) (White et al., 2009). In the context of self-presentation, it can be assumed that adolescents take into consideration what is expected of them by others when making decisions about how they present themselves online. For example, research on the positive bias on social media (i.e., the highly selective, curated, and unspontaneous stream of content where a favorable self-presentation dominates; Schreurs & Vandenbosch, 2021) has revealed that adolescents who are aware of this bias are more likely to engage in positivity biased behaviors themselves, such as posting edited photos (Schreurs & Vandenbosch, 2022) or actively searching digital status

indicators (Trekels et al., 2024). Moreover, these decisions are significantly influenced by the audience adolescents imagine will see their posts, taking into account factors like whether the content will be ephemeral (fleeting), private, or public. Driven by developmental and cognitive progress linked to the separation-individuation process, this imaginary audience, or the belief to be the object of others' attention and evaluation, peaks during adolescence (Cingel & Krcmar, 2014). Importantly, the awareness of this audience—whether real or imagined—can hold users accountable for their actions and thereby influence social media-related choices (Litt, 2012; Stsiampkouskaya et al., 2021).

### The stream

A second prominent social media element is the stream, which refers to the constant flow of information. Social media offer a unique catalog of other people's lives as well as the responses received from their network and can therefore naturally lend themselves to social comparison processes (Bayer et al., 2020). We propose that mere exposure to this stream of highly curated and therefore oftentimes idealized content may not be sufficient to understand its potential influence on individuals (see mixed findings found across meta-analyses; Odgers & Jensen, 2020). Instead, it is the social cues surrounding the content that codetermine its impact. Specifically, following the tenets of warranting theory, the less editorial control users have over a piece of information the more that information is viewed as credible (DeAndrea, 2014). In this regard, status signals and thus the endorsement of content by others may shape perceptions and the associated effects. Notably, the bandwagon effect describes a phenomenon where people internalize certain messages because they believe that others around them are doing the same (Kim, 2021). In an online context, bandwagon cues refer to any representation of collective reactions to online content, including views and likes, and are also known as social endorsement cues (Messing & Westwood, 2014), which are particularly relevant in the context of our model. Notably, research among adolescents shows that 'likes' can elicit neural and behavioral responses; when adolescents view photos with many (as compared to few) likes—regardless of the content being risky or neutral—their neural activation in reward-related regions increases, influencing their likelihood of liking the photo (Sherman et al., 2016). Consequently, the functional value of these social cues plays a pivotal role in shaping negative social media effects.

### The connection

Lastly, we acknowledge the connection element in social media, which combines the network and message elements (Bayer et al., 2020). Adolescents' extensive use of social media is believed to be driven by its capacity to fulfill social needs, such as a sense of belongingness and connection. With the prevalence of mobile technology enabling constant connectivity, the immediate gratification of these needs has become the norm. Surely these affordances can make social media highly adaptive in assisting adolescents to seek the social support they crave at a certain time, fostering a sense of belonging and alleviating feelings of isolation (Verduyn et al., 2017). In addition, social media provide social connection in ways not available in real life—such as facilitating having online only friends—which has been shown to be particularly protective for at-risk teens (Massing-Schaffer et al., 2022).

On the other hand, negative effects may arise when needs of connectedness are unmet or when stressors emerge. Indeed, some studies suggest that adolescents can experience digital stress (Nick et al., 2022) and ostracism (i.e., being ignored or excluded by others; Williams, 2009) which may in turn result in feelings of alienation and depression.

## The social dynamics surrounding social media use

The assumption that an individual's use of social media is influenced by a larger social context has been the focus of some media research (Carter et al., 2023; Friemel, 2021). The networked effects framework recognizes individuals as embedded within networks connecting them to other users and media content, emphasizing that their actions on social media are not isolated but shaped by these networks and, in turn, impact the social context for others (Friemel, 2021). While not currently within the scope of this manuscript, it is crucial to acknowledge that adolescents' online content is not solely dictated by their own social network but influenced by algorithms and thus shaped by adolescents' own behaviors online. Within the Swiss Cheese Model, we specifically aim to establish the significance of family and peers<sup>2</sup> as crucial social contexts that shape adolescents' use of social media, while also being influenced and affected by it. Importantly, the social dynamics within one's immediate environment can both be real or imagined as well as operate on both an abstract level (e.g., social standing such as perceived popularity or relationships with family and friends) and through physical copresence during social media use. Together, these factors shape and are shaped by how adolescents experience and respond to social media.

### Peer context

Substantial research has documented the crucial role of peer context in shaping adolescent development and well-being (e.g., Nesi et al., 2018). Compared to children, adolescents spend significantly more time in the company of their peers and are more receptive to peer influence and peer rejection than adults (e.g., Silvers et al., 2012). Within the context of social media, the type of content adolescents is exposed to can vary based on the characteristics of their friendship clique. Body image scholarship, for instance, has revealed that adolescents in appearance-focused cliques are more likely to encounter appearance-related content, potentially feeling pressured to conform to certain beauty standards (Paxton et al., 1999). Likewise, if a peer group emphasizes constant availability and responsiveness on social media, adolescents may face digital stress in their friendships (De Groote & Van Ouytsel, 2022). The increased stress from peer interactions (Silvers et al., 2012) underscores how the characteristics of one's social network influence social media experiences.

Another crucial dimension of the peer context influencing social media experiences and effects is the dynamics of social relationships and networks, including social status. The social status of adolescents within both offline and online networks can shape their engagement with social media and its influence on them. For instance, individuals experiencing social isolation or lacking strong friendship ties in both online and offline contexts may rely more on social media for social interaction and validation. During social exclusion, seeking support becomes likely, particularly if acceptance appears



secure (Bayer et al., 2018). The constant connectivity provided by mobile technology and social media allows adolescents to access this support. Similarly, those with well-established friendship networks may use social media to maintain and strengthen existing connections (i.e., the rich-get-richer hypothesis; Bouchillon, 2022).

Additionally, research has shown that adolescents with higher levels of peer acceptance (i.e., likeability) are likely to possess higher levels of emotional competence (Mavroveli et al., 2007)—encompassing emotional intelligence and regulation—which, in turn, have been considered crucial components of social media literacy (Schreurs & Vandenbosch, 2021). Consequently, likeable adolescents might use emotional regulation skills during stressful online experiences and as such may be more resilient in their social media use. Furthermore, there is literature indicating that having one or two close friends might be a sufficient buffer against the risk associated with other social difficulties, such as low social status, rejection, or peer victimization (Laursen et al., 2007). This type of buffering effect has also been established for having online only friends (Massing-Schaffer et al., 2022). These findings show the importance of considering adolescent's position within their social network as a crucial condition shaping social media use and effects.

### Family context

In the realm of adolescent development, parents and other caregivers continue to hold a significant role alongside the increasing influence of peers (Grusec & Hastings, 2014). Parents have been grappling ways to help their children navigate the digital world safely and are thus likely to shape adolescents' social media use and their ability to navigate it in a healthy manner. This active involvement of parents in mediating their children's media behavior is commonly referred to as parental mediation (Daneels & Vanwynsberghe, 2017). Within the context of social media, parents employ various strategies such as open communication (active mediation), setting limitations (restrictive mediation), and participating in their children's online activities through co-use. These efforts aim to assist adolescents in developing a balanced approach to social media and reducing potential negative effects.

The research on parental mediation in the context of social media use, however, is not entirely conclusive. Restrictive mediation and co-use may pose challenges for parents due to limited knowledge about these technologies (Daneels & Vanwynsberghe, 2017). Additionally, intrusive attempts by parents to control their children's online behaviors have encountered mistrust and resistance, hindering adolescents' autonomy (Kerr et al., 2010). Still, actively discussing certain aspects of online media, including the presence of online positivity bias (Schreurs & Vandenbosch, 2021), has shown potential to enhance children's media literacy. For successful active mediation, children need to be willing to share their (online) experiences with their parents. While limited research directly links disclosure to family quality, there are indications that such sharing is more common in cohesive families (Dost-Gözkın, 2022).

It is thus worth considering the indirect influence of the parental context on adolescents' ability to navigate the positive and negative aspects of social media interactions. Specifically, a supportive environment created by parents can foster resilience (Morris et al., 2017). Following family development perspectives, family cohesion has been linked with decreased

emotional distress and anxiety through the mechanisms of increased effortful control and self-regulation (Augustine et al., 2022). Through its association with enhanced self-regulatory skills, higher affective quality of family relationships may encourage more responsible social media use among adolescents. This highlights the importance of the parental role in shaping their children's experiences with social media and promoting their well-being in the digital age.

Siblings are also likely to play a significant role in shaping adolescents' experiences with social media. Research has demonstrated that frequent communication and close relationships between siblings are closely linked, suggesting that strong sibling bonds can have a profound impact on an adolescent's social and emotional development (LeBouef & Dworkin, 2021). Sibling relationships often provide an additional layer of social support that can buffer against the negative effects of social challenges, sometimes even more effectively than relationships with parents or peers (Fry et al., 2021). For instance, the warmth exhibited by older siblings has been shown to protect against the development of externalizing behaviors in younger siblings, highlighting the importance of sibling interactions in mitigating the impact of social problems. Additionally, siblings influence media consumption patterns and the resulting effects, with studies suggesting that children with siblings often exhibit healthier media habits, yet they may also be more vulnerable to media influences due to the social modeling provided by their siblings (Davies & Gentile, 2012). This dual role of siblings—as both protective factors and potential conduits for media influence—underscores their importance in understanding the social media effects on adolescent well-being.

### Real vs imagined social environment

When examining the influence of the social context on adolescents' use of social media, the environment may be considered from two distinct perspectives. The first perspective is the objective reality of the environment, which includes tangible factors such as peer-nominated status indicators (e.g., popularity) or explicit social norms. This aspect reflects the actual social landscape in which adolescents navigate their social media interactions. For instance, sociometric scores can provide insight into the hierarchical structure within a peer group and the perceived social status associated with different individuals.

The second perspective involves the perceived reality, which encompasses the subjective experiences and interpretations of individuals within their social context. This subjective representation of the environment is constructed and shaped by the individual's own thoughts, beliefs, and emotions. In the context of social media, adolescents' perceived reality may be influenced by their own interpretations of the content they encounter, the feedback they receive from peers, their own self-perception in relation to others, and norm perceptions. Importantly, this subjective experience can also significantly impact their behaviors and interactions on social media platforms.

By considering both the external factors and the internal representations within the minds of individuals, we can gain insights into the complex dynamics that contribute to adolescents' engagement with social media and its impact on their social experiences.

## Physical copresence

The location and social context in which adolescents use social media significantly shape their experiences and behaviors (Dogruel & Schnauber-Stockmann, 2021; Masur et al., 2022; Vanden Abeele, 2021). Research on mobile communication patterns has demonstrated that users often engage in brief, frequent bursts of app use, or “micro-usage,” particularly when they are at home or alone (Ferreira et al., 2014). Additionally, the presence of others plays a crucial role in shaping responsiveness to messages. When users are surrounded by close individuals, such as family members or partners, they tend to be less responsive to messages or may avoid sending them altogether, compared to when they are with more distant contacts or strangers (Lee et al., 2019; Shuter & Chattopadhyay, 2010).

In the context of adolescent development, the presence of peers and parents/caregivers creates distinct social environments that can profoundly influence adolescents’ social media experiences. Peers, in particular, can heighten adolescents’ sensitivity to social rewards, driving them to seek immediate social gains. This heightened sensitivity is linked to increased activation in brain regions associated with reward valuation (O’Brien et al., 2011). Although this has not been extensively studied, it is likely that peer presence also affects social media-related decisions by making social rewards more salient. For example, adolescents might opt for image-enhancing filters or engage in risky online behaviors (e.g., risky self-disclosure) to gain (immediate) social recognition or approval.

Conversely, the presence of parents or caregivers can act as a protective buffer, potentially guiding adolescents toward more thoughtful and less impulsive social media use. Research suggests that caregivers enhance adolescents’ cognitive control, which can reduce engagement in risky behaviors when they are present (e.g., Telzer et al., 2023). The influence of caregivers involves mechanisms like scaffolding, which diminishes the allure of risky behaviors and helps balance reward-seeking with cognitive control. For instance, studies have shown that the presence of a caregiver can increase the rewarding nature of engaging in self-regulation (Telzer et al., 2023). Future research could explore whether caregivers influence adolescents’ social media behavior by triggering reward-related responses that encourage more mindful and controlled use.

Thus, primary socialization contexts—whether shaped by peers or caregivers—play a critical role in determining how adolescents interact with social media and make decisions about their online behavior. Understanding these dynamics is essential for a comprehensive analysis of social media’s impact on adolescent well-being, as outlined in the Swiss Cheese Model of Social Cues.

## Individual (neuro)sensitivity to social cues

Early adolescence often marks the first entry into the digital world (Livingstone et al., 2011). Concurrently, this developmental stage is characterized by neurobiological changes that increase teens’ responsiveness to their social context (Schriber & Guyer, 2016), which can intensify their motivation to pursue peer connections and social status (Crone & Dahl, 2012).

According to the theory of neurobiological susceptibility to the environment (Schriber & Guyer, 2016), there is notable

individual variability in how responsive individuals are to their social context, such that some youth have high neurobiological sensitivity, and other youth have low neurobiological sensitivity. Whereas youth with low sensitivity are resilient to their social context, heightened sensitivity guides adolescents to prioritize elements that hold particular relevance within the social setting. For instance, adolescents with heightened neural connectivity in the affective salience network of the brain are more sensitive to their peer context, such that they engage in risk taking when exposed to negative peer norms but engage in prosocial behaviors when exposed to positive peer norms. Importantly, adolescents with low neural connectivity appear to be resistant to peer group norms (Do et al., 2022).

With the premise that individual differences in neurobiological sensitivity interact with the social context in predicting adolescent behavior (Telzer et al., 2021), acknowledging individual susceptibility in the context of social media use becomes paramount. As a significant and growing social context during adolescence, the impact of social media on adolescent well-being is likely to be shaped by an individuals’ attunement to social cues, including likes, norms, expectations, etc. Research exploring the brain-related aspects of social media effects—with either brain development as an outcome of social media effects (e.g., Maza et al., 2023) or the brain as a factor influencing the effects of social media on mental health (e.g., Authors, submitted manuscript)—are only beginning to emerge, but already underscore its significance.

Another fruitful approach to consider the brain within social media effects involves understanding the mechanisms underlying cognitive control and self-regulation. Specifically, the greater plasticity in adolescent brains helps them to adapt to their environment and effectively channel their attention and motivation toward cues they value (Telzer et al., 2023). Within a social media context, we argue that the very elements capturing adolescents’ attention—social cues like likes, followers, etc.—might also constrain their self-regulatory impulses. Notably, a pivotal aspect of resilient social media use is attention control—involving the ability to redirect attention from negative to positive interactions—which underpins self-regulation (Dishion & Connell, 2006). Adolescents have demonstrated flexible cognitive control, heavily contingent on environmental factors (see Davidow et al., 2018). If sensitive adolescents are confronted with social cues (e.g., within social media but also their social networks), their capacity to engage their self-regulatory abilities might be compromised, affecting their ability to resist adverse social media interactions and concentrate on more positive ones.

A crucial point to emphasize is that other dispositional factors (e.g., personality and self-esteem) are equally important individual boundary conditions for (social) media effects, as proposed by the differential susceptibility to media effects model (Valkenburg & Peter, 2013). However, the present theoretical manuscript seeks to integrate adolescents’ neurobiological susceptibility into social media effects research. Therefore, we propose that individuals vary in their susceptibility to social information, driven by neurobiological sensitivity, which influences how they respond to social cues within the online environment (Assumption of Individual Susceptibility).

## The interplay of different resilience factors

With nearly one in five U.S. adolescents reporting that they are virtually always online, and two out of three using social media daily (Vogels et al., 2022), it is crucial to understand the dual nature of social media: a tool that can be both beneficial and challenging. To explore when and how adolescents adaptively navigate negative interactions (i.e., resilient social media use), we have proposed dissecting the intricate interplay of relevant social cues. We emphasize that individual resilience factors (e.g., strong peer/parent connections) may not singularly protect youth from negative social media effects or harness positive ones. Instead, research should consider the concurrent interplay of the multifaceted layers.

We posit that a negative social media effect arises when an adverse social media experience aligns with a convergence of social cue-related factors, leading to a negative outcome. Additionally, a negative effect might be either prevented or attenuated when certain layers of influence obstruct its impact, a phenomenon we refer to as resilient social media use. As such, the Swiss Cheese Model of Social Cues incorporates the Collective Influence Assumption: The dynamic and multifaceted collective influence of the proposed social cues—those within the platforms, the social environment, and one's individual susceptibility to social cues—shapes both social media use behaviors and their effects on well-being. The interaction among these factors results in a range of well-being effects and social media use behaviors, which may be amplified or attenuated based on the specific combination of influences in a given context.

Although the Swiss Cheese Model of Social Cues contends that comprehending the use and effects of social media necessitates a broader perspective encompassing various social cues, it is equally important to note that not all types of social cues are essential for generating an “effect,” and there is no predetermined sequential order among these different types of cues. Overall, the starting point of the model is some form of social media use/engagement/exposure with some form of psychosocial outcome as the end point. A ricochet arrow symbolizes resilient social media use where a negative effect is prevented or attenuated (see Figure 1). Notably, the strength of a negative social media effect is likely contingent upon the specific composition of the suggested layers and cues within the model.

To demonstrate the innate adaptability of the Swiss Cheese Model, we will illustrate its applicability against the background of digital stress and positivity bias exposure.

### Digital stress

Digital stress, characterized as the “stress arising from extensive and potentially constant use of information and communication technology ... triggered by constant exposure to an overwhelming quantity and diversity of (social) content” (Hefner and Vorderer, 2016, p. 237) is a multifaceted phenomenon. Researchers have identified five subcomponents of digital stress (i.e., availability stress, approval anxiety, fear of missing out, connection overload, and online vigilance; Steele et al., 2020), all of which have been associated with psychosocial stress (see recent meta-analysis; Khetawat & Steele, 2023). However, not all studies reveal significant associations between digital stress and compromised psychosocial well-being (e.g., Best et al., 2014). It is argued that digital stress is subjective, and often contingent on an individual's coping

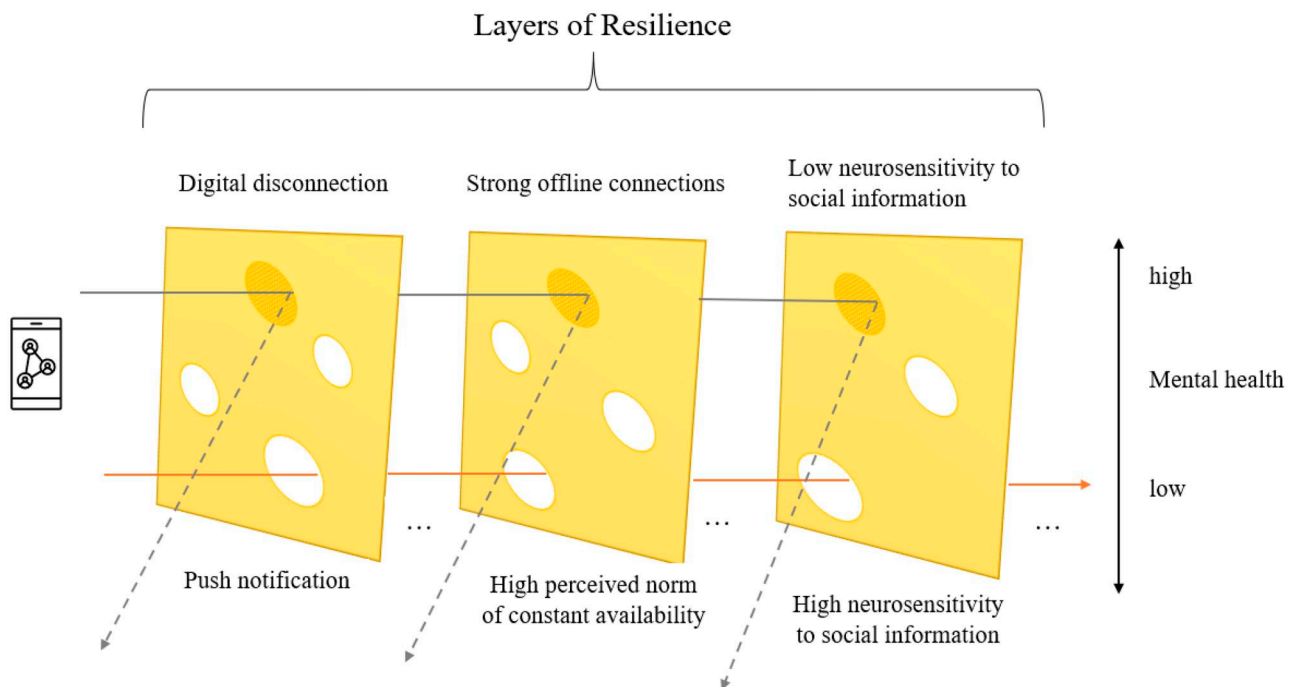
resources and environmental, social, and relational demands (Khetawat & Steele, 2023). In this context, the Swiss Cheese Model of Social Cues suggests that several social cues may play a crucial role in determining one's capacity to navigate stressful social media interactions (see Figure 2 for a visual representation).

Relevant social cues within the social dynamics surrounding social media use relate to the profound connection between self-concept and the social sphere during this developmental stage, making adolescents often feel socially obligated to promptly respond to friends' messages (De Groote & Van Ouytsel, 2022). Individuals shape their behavior to create impressions that lead to peer acceptance, social status, and validation of a positive self-image (Bell, 2019). Not surprisingly, then, one's social status and susceptibility to inclusion/rejection have been linked with increased stress responses to relational stressors (Estévez et al., 2014). Additionally, normative perceptions of social media demands, like constant accessibility, have been shown to explain both smartphone misuse (Vanden Abeele et al., 2022) and its effect on well-being (Nick et al., 2022). Moreover, dynamics within friend groups may accentuate this perception of the need for constant availability and reciprocity. Within the *platforms itself*, apparent social cues that can increase feelings of digital stress are the number of messages and push notifications (Steele et al., 2020). The Swiss Cheese Model of Social Cues also theorizes potential protective (i.e., resilience) factors. Within the context of digital stress, such factors include digital disconnection—limiting the number of notifications received (Vanden Abeele et al., 2022)—and having close connections with family and friends. The latter have been shown to act as buffers against negative life events (e.g., Telzer et al., 2023), although their role in *online* stressful situations remains unexplored.

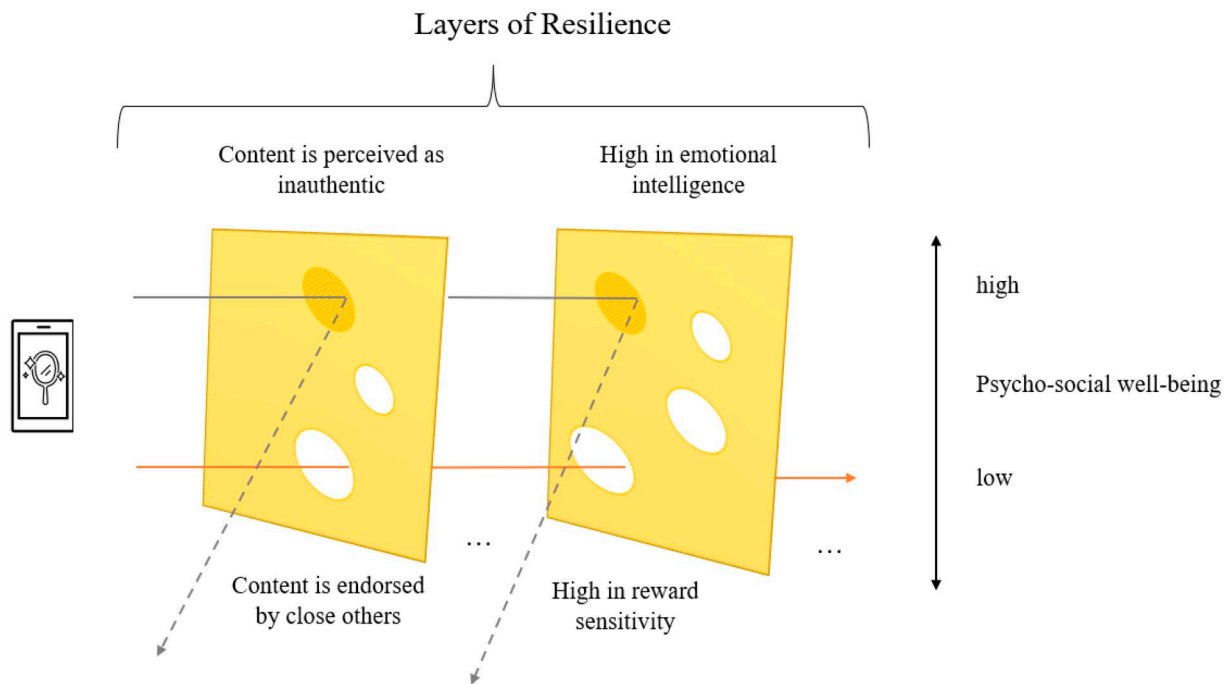
When investigating digital stress in adolescents, then, we argue that research should consider users' social network position, including acceptance/rejection, social connections, and normative perceptions. Individuals less attuned to this social information, coupled with stronger offline connections, may feel less socially obligated for constant online availability, potentially reducing susceptibility to digital stress. This suggests a promising direction for future research on understanding and mitigating this phenomenon among adolescents. Lastly, the social cues adolescents receive from platforms (e.g., high notifications or none when disconnected) will also influence their experience of digital stress.

### Positivity bias online

Social media platforms are teeming with positively biased content. Specifically, users—and especially adolescents—strategically curate and select content to present a carefully constructed positive self-image (Bell, 2019). A prime example of this practice is the widespread use of image-enhancing filters, resulting in an abundance of idealized pictures on social media. Exposure to such content might trigger social comparison processes (Haferkamp & Krämer, 2011), often resulting in upward comparisons. These upward comparisons can take two distinct paths. For individuals who strongly believe in their ability to control personal outcomes, such comparisons can evoke self-improvement motivations. Such individuals feel they can enhance themselves or avert potential failures, making upward comparisons a source of inspiration rather than a threat (Haferkamp & Krämer, 2011). For others,



**Figure 2.** Visualization of the Swiss Cheese Model in the context of digital stress.



**Figure 3.** Visualization of the Swiss Cheese Model in the context of the positivity bias.

social comparison with this idealized content might trigger negative affect and self-perceptions (e.g., [de Vries & Kühne, 2015](#)).

The Swiss Cheese Model of Social Cues suggests that adolescents' engagement in social media comparisons and their emotional responses hinge on specific cues (see [Figure 3](#) for a visual representation). Notably, research on idealized social media exposure highlights the influential role of likes and comments as bandwagon cues, amplifying or diminishing the impact of posted content ([Kim, 2021](#)). Warranting theory

([DeAndrea, 2014](#)) further explains this, emphasizing that information shared by others carries more weight than self-posted content, influencing perceptions, such as social attractiveness ([Antheunis & Schouten, 2011](#)). Neurobiologically, likes activate adolescent brain's reward circuitry ([Sherman et al., 2018](#)). Quantifiable social endorsement (e.g., likes on idealized images) thereby serves as a significant socialization cue.

Moreover, the Swiss Cheese Model of Social Cues offers insights into adolescents' decisions to partake in positivity-



biased behaviors themselves. Notably, perceptions of social norms and the imagined audience play a role in various social media-related behaviors, such as self-presentation (Zillich & Riesmeyer, 2021). Drawing on impression management theory (Leary & Jongman-Sereno, 2017), individuals often choose to share images on social media driven by a desire for impression management and the anticipation of positive feedback (Bell, 2019). Hence, it follows that those more sensitive to social feedback from friends and peers may be more inclined to seek it online and engage in positivity-biased behaviors.

Conversely, the pursuit of authentic self-expression represents the opposite end of the spectrum. Studies have linked making authentic self-presentations online to lower levels of depressive symptoms (Wang et al., 2019). Authenticity correlates with personality traits like extraversion, agreeableness, emotional stability, and self-regulation (Kreling et al., 2021), traits often found in well-liked adolescents (Frederickson et al., 2012). Emotional intelligence and regulation, associated with higher sociability in adolescents, are crucial components of social media literacy (Schreurs & Vandenbosch, 2021). It could be argued that well-liked adolescents are more likely to possess the emotional and cognitive skills to consider potential drawbacks of engaging in positivity-biased online behaviors (i.e., being considered inauthentic). Consequently, they might opt for authentic self-presentation. However, empirical studies are necessary to validate and substantiate this reasoning.

In sum, adolescents' participation in the positivity bias and its effect on well-being may yield different outcomes for different individuals. These outcomes hinge on a specific combination of social cues within the platform, an individual's sensitivity to social information, and their position within the peer network.

## Implications and directions for future research

The Swiss Cheese Model of Social Cues acknowledges the variability in social media effects among users, emphasizing that understanding the link between social media use and well-being requires exploring the broader social context. By viewing social context as a series of nested layers of resilience—either protecting adolescents or exposing them to challenges—our model explains the observed individual differences in social media effects. This framework is particularly suited for adolescents, who are highly sensitive to social information and thus more vulnerable to both positive and negative effects. We believe that our model addresses both short- and long-term impacts: While the concept of physical copresence during social media use primarily addresses short-term outcomes, focusing on how a specific setting or context may influence immediate behaviors and interactions, adolescents' sustained social media use is associated with more cumulative effects over time. These prolonged patterns likely interact with key developmental processes, affecting well-being, allowing the model to capture how short-term dynamics can evolve into lasting developmental outcomes.

To assess the model and delve into the dynamic associations among social cues in the context of social media use, we propose employing a diverse set of research methodologies. Experimental designs allow to examine both causal and situational effects. Longitudinal and diary studies offer insights into the endurance of hypothesized effects and their external

validity. Utilizing measurement burst designs, which combine diary and longitudinal approaches, can illuminate how individuals with resilient social media use continue to enhance their well-being and resilience in online interactions. Sociometric investigations are crucial for exploring how adolescents' objectively measured social status influences their social media use, and social network analyses can enrich our understanding of how social media use and effects propagate within a peer network. To investigate whether social media use triggers brain activation or if neurobiological sensitivities can mitigate examined social media effects, functional magnetic resonance imaging designs are essential. Lastly, dyadic research involving parents could augment the ecological validity of understanding the role of parents in the context of social media effects.

## Conclusion

In summary, the Swiss Cheese Model of Social Cues presents a dynamic framework for examining the complex interplay between social media use and well-being, especially in the context of adolescents. Through its consideration of the multifaceted layers of social cues within platforms, the social environment, and individual (neuro)susceptibility, this model offers insights into the elements that foster resilient social media use. It paves the way for comprehending and promoting the well-being of adolescents in the digital age, recognizing the distinctive social context shaping their online experiences.

## Data availability

No data were used in this manuscript.

## Author contributions

Jolien Trekels (Conceptualization [lead], writing—original draft [lead] and Eva H. Telzer (Conceptualization [supporting], writing—review and editing [equal], funding acquisition). All authors read and approved the final manuscript.

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## Disclosure statement

Prior deposit of manuscript in a Preprint database. This manuscript was preprinted on OSF (link: <https://doi.org/10.31219/osf.io/tvr84>).

## Notes

1. An important caveat to mention is that social media use is not equivalent to social interaction (Hall, 2018). Instead, this work builds on previous studies (Throuvala et al., 2019; Wong & McLellan, 2024) which suggest that adolescents' primary motivations for using social media are inherently social, such as peer comparison, forming relationships with peers, and constructing social reality.
2. There are many other important social figures that can also affect adolescents' social media experiences, including teachers and coaches. For instance, the increasing implementation of smartphone bans in schools underscores the role of the school environment as a key social context that shapes adolescents' engagement with social media and its impact on their well-being. Such bans establish boundaries within the school setting, which can either limit or create new opportunities for how young people interact with and experience social media, influencing their overall digital habits and social development.

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