Longitudinal Associations Between Adolescent Social Media Use and Depressive

Symptoms: The Roles of Appearance-Related Social Media Consciousness and Gender

by

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Submitted to the Graduate Faculty of the

Dietrich School of Arts and Sciences in partial fulfillment

of the requirements for the degree of

Master of Science

University of Pittsburgh

2020

UNIVERSITY OF PITTSBURGH

DIETRICH SCHOOL OF ARTS AND SCIENCES

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Longitudinal Associations Between Adolescent Social Media Use and Depressive Symptoms: The Roles of Appearance-Related Social Media Consciousness and Gender

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Social media use among adolescents is nearly ubiquitous and has been associated with heightened depressive symptoms, especially for girls. Increasingly, researchers are considering the role of subjective social media experiences as driving this association, rather than mere frequency of use. Key features of adolescent development (e.g., importance of peers), aspects unique to social media use (e.g., highly visual platforms), and cultural norms of gender socialization (e.g., girls value their physical appearance more), make adolescents, especially girls, vulnerable to a particular social media experience: *appearance-related social media consciousness* (ASMC). ASMC is the preoccupation with one's physical attractiveness in social media photos and has been found to be cross-sectionally associated with depressive symptoms above and beyond frequency of social media use. The present study assessed this association longitudinally with a diverse sample of adolescents (M_{age} = 16.19, 55.8% female, 50.9% White, 24.5% Black, 28.2% Hispanic) in a high school setting in the Southeastern U.S. Analyses compared the role of ASMC as a moderator or mediator of the association between time spent on social media and depressive symptoms one year later. ASMC was associated longitudinally with increased depressive symptoms, though it did not mediate or moderate the link between time on social media and depressive symptoms in the full sample. However, among girls only, ASMC did mediate this association, suggesting that increased ASMC may help explain the link between time on social media and depressive symptoms among adolescent girls. Potential gender differences in vulnerability to highly-visual, appearance-based social media use, as well as implications for

intervention, are discussed.

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1.0 Introduction

There exists much debate regarding the psychological impact of social media use for adolescents. Social media refers to online platforms that allow users to communicate with others and post original text-based and visual content to semi-public forums. A recent Pew report indicates that smartphones and social media use are now nearly ubiquitous: 95% of teens have access to a smartphone and 89% of teens report going online multiple times a day, with girls reporting more social media use than their male peers (Smith & Anderson, 2018). Despite its ubiquity, nearly 75% of teens report that social media has a mostly negative or neutral effect on people their age (Smith & Anderson, 2018).

Evidence linking social media use to mental health symptoms in adolescence, particularly depressive symptoms and negative affect, has been mixed. Some studies find a relationship (Coyne, Padilla-Walker, Holmgren, & Stockdale, 2018; Houghton et al., 2018), while others report no association (Heffer, Good, Daly, MacDonell, & Willoughby, 2019; van der Velden, Setti, van der Meulen, & Das, 2019). These associations are often confounded by a multitude of moderating factors. For example, the association between social media use and depressive symptoms appears stronger for adolescent girls than boys (e.g., McCrae, Gettings, & Purssell, 2017). Despite the mixed results, a number of systematic literature reviews and meta-analyses conclude that there is indeed a relationship between frequency of social media use and depressive symptoms, albeit a complicated one (Baker & Algorta, 2016; Keles, McCrae, & Grealish, 2019; Yoon, Kleinman, Mertz, & Brannick, 2019).

Many scholars have come to argue that this association is driven less by time spent on social media, and more by *how* adolescents use social media (Keles et al., 2019). Aspects of social

media fundamentally transform how adolescents interact with their peers and their online world (Nesi, Choukas-Bradley, & Prinstein, 2018), and many scholars have implicated the visual nature of social media as driving much of the association with depressive symptoms. Although some studies have considered how specific activities on social media (e.g., posting "selfies"; McLean, Paxton, Wertheim, & Masters, 2015) or specific features of social media (e.g., photo-based apps; Marengo, Longobardi, Fabris, & Settanni, 2018) affect mental health, few studies have considered the psychological experience of the visual aspects of social media. Two individuals performing the same behaviors on social media sites may internalize their experience differently, necessitating a closer examination of how time spent on social media is linked to particular subjective experiences, which may then lead to depressive symptoms.

Appearance-related social media consciousness (ASMC), a recently developed psychological construct, is the "extent to which individuals' thoughts and behaviors reflect ongoing awareness of whether they might look attractive to a social media audience" (Choukas-Bradley, Nesi, Widman, & Galla, 2020). Aspects of ASMC include seeking to curate an idealized image of oneself on social media, experiencing persistent thoughts of an imaginary social media audience, remaining vigilant about one's appearance on social media, and prioritizing one's appearance over other aspects of one's life on social media (Choukas-Bradley et al., 2020). Preliminary cross-sectional work suggests that ASMC may capture a distinct psychological experience and uniquely explain variance in psychological well-being and mental health among adolescents (Choukas-Bradley et al., 2020; Choukas-Bradley, Nesi, Widman, & Higgins, 2019). In a recent study using the newly developed ASMC scale, adolescents with greater ASMC experiences reported more mental health concerns, such as depression, body shame, and higher

disordered eating, even after controlling for time spent on social media (Choukas-Bradley et al., 2020).

Studies of this construct have so far been only correlational, and thus limit inferences of temporality that can be made. Furthermore, given the focus in the literature on *time spent* on social media, research should consider how ASMC may help explain the tenuous relationship found between frequency of social media use and mental health. The present study seeks to examine the association between ASMC and depressive symptoms over time for adolescents, investigate the role of ASMC as a potential mediator or moderator in the link between time spent on social media and depressive symptoms, and explore the role of gender in these associations.

1.1 Adolescence and Social Media

Adolescence, the developmental stage between childhood and adulthood, is a transformative period of intense physical, neural, cognitive, social, and emotional changes. Adolescents contend with important issues as they transition into adulthood, including identity exploration, navigating romantic and sexual relationships, and seeking peer approval and peer status (Brechwald & Prinstein, 2011; Dahl, Allen, Wilbrecht, & Suleiman, 2018). Decades of research on adolescent developmental processes, along with relatively new research identifying what makes social media different from face-to-face interactions or other forms of media consumption, help explain why and how adolescents use social media.

Many features of social media appeal to key adolescent values and motivations. The *transformation framework* identifies six aspects of social media that fundamentally transform adolescent experiences online: *asynchronicity*, or the time lapse within conversations;

permanence, or the enduring nature of content posted online; *publicness*, or the possibility for social media content to be shared with large online networks; *availability*, or the nearly constant option of connecting online; *cue absence,* or the lack of nonverbal signals of interpersonal expression; *quantifiability,* or the potential for approval to be expressed in numerical metrics such as "likes" and "followers"; and *visualness,* or the way social media emphasizes photos and videos (Nesi et al., 2018). Many of these features may explain why social media is especially captivating for adolescents, and why they may be particularly vulnerable to potential negative outcomes arising from social media use.

As young people gain independence from their families of origin, peer affiliation becomes of the utmost importance to adolescents (Brown & Larson, 2019). Not surprisingly, adolescents self-report communication with peer groups as their primary reason for using social media (Barker, 2009). The asynchronicity and availability of social media make online interactions possible at all times, creating more opportunities—but also potentially greater pressure—for adolescents to engage with or be visible to peers (Nesi et al., 2018). In seeking a positive self-identity, adolescents are also particularly motivated to achieve peer approval and status (Brechwald & Prinstein, 2011), which likely affects how teens present themselves on social media. Quantifiable metrics of approval, including "likes," "retweets," "shares" and "followers" provide adolescents with undeniable feedback of their status relative to their peers (Nesi et al., 2018), and adolescents actively use these metrics to seek peer feedback (Nesi & Prinstein, 2015).

Peers also serve as salient targets of comparison which adolescents use to make sense of societal standards as they develop their unique identities (Krayer, Ingledew, & Iphofen, 2008). Festinger's *social comparison theory* (1954) posits that humans are prone to evaluate themselves. When lacking in objective indicators of merit, people will compare themselves to peers in order to

gauge their relative skills and abilities compared to similar others. In Western culture, where societal norms value exponential improvement for most abilities, people also tend to compare themselves upwards. This human tendency helps explain why comparisons made with peers on social media may lead to greater negative outcomes than comparisons in person or with individuals in other forms of media (Fardouly, Pinkus, & Vartanian, 2017). Models and celebrities seen in television and magazines may appear too dissimilar from the self to compare against, yet images of peers—though idealized through careful curation or editing techniques—appear to be comparable targets of upward comparison. Adolescents, who have constant access to photos of both themselves and their peers, readily engage in social comparison on social media, including with these deceiving and unrealistic peer images (Nesi & Prinstein, 2015).

As adolescents develop cognitively, they experience an egocentric preoccupation with how others perceive their appearance and behavior—an *imaginary audience* (Elkind, 1967; Galanaki, 2012). These thoughts arise from normal developmental processes of cognitive maturation and an awareness of one's physical changes, yet may be distorted in an era of ubiquitous social media use. The permanent, public, and visual nature of social media allows adolescents to believe that their original content—particularly images of themselves—may be scrutinized by their entire online networks at any time (Nesi et al., 2018). The pressure of presenting oneself in front of an actual online audience, when concerns about one's presentation to peers is already so important, may alter how individuals use social media and represent themselves online (Ranzini & Hoek, 2017).

Additionally, the experience of the imaginary audience, as well as the importance of peers, peer status, and romantic interests during adolescence, contribute to an increasing emphasis on physical appearance. Some researchers describe an *appearance culture* among adolescents,

stressing how exposure to attractive others in media, conversations with friends about appearance, and appearance-related criticism by peers are readily internalized by adolescents (Jones, Vigfusdottir, & Lee, 2004). Undoubtedly, the visual nature of social media exacerbates these processes. In terms of peer status, attractiveness is highly correlated with popularity in adolescence, especially for girls (Kennedy, 1989; Lease, Kennedy, & Axelrod, 2002). As adolescents seek peer approval and status, they may be motivated to present a highly attractive representation of themselves on social media, and feel distress when these attempts fall short.

Concerns about how one appears to others—and especially how attractive one appears to others—may prompt adolescents to seek to control their online presentation. Well before the advent of social media, Leary and Kowalski (1990) proposed a conceptual model of *impression management*, predicated on the notion that people are motivated to control the impressions others form of them, determine the kind of impression they want to make, and seek to construct that impression. Although impression management is not necessarily problematic, multiple health risk behaviors, such as disordered eating or sunbathing, may be pursued to increase one's physical attractiveness and likely originate from impression management motivations (Leary, Tchividjian, & Kraxberger, 1994). In modern culture, impression management concerns also manifest in the careful curation of the images presented of oneself online. The ubiquity of advanced camera technology allows control of the images taken, while photo-based social media apps allow users to modulate their appearance through editing techniques and filters (Fox & Vendemia, 2016). The motivation to manage the impression one makes on others is especially strong in adolescence, given the focus on peers, status, and appearance, and is heightened in the sphere of social media by the permanent, public nature of one's photographs online.

Extensive neurobiological development during adolescence, especially the maturation of social and affective processing regions of the brain, underpins these social and cultural changes that draw adolescents to social media. The network of brain regions known as the "social brain," which includes the medial prefrontal cortex (mPFC) and temporoparietal junction, undergoes structural and functional change to allow for more complex, pro-social behaviors during adolescence (Crone & Dahl, 2012). Social-affective regions, such as the ventral anterior cingulate cortex and striatum, also develop during this time, making rejection more painful and social acceptance more desirable for adolescents (Crone & Dahl, 2012). These neurobiological changes help explain adolescents' motivation to engage with peers and seek peer feedback (Dahl, Allen, Wilbrecht, & Suleiman, 2018), behaviors made increasingly available through social media. Novel functional magnetic resonance imaging (fMRI) techniques have begun to reveal the neurobiological effect of social media use during adolescence. For example, one study found that photos with many *likes* (i.e., peer endorsement) elicited greater activity in neural regions associated with reward processing and social cognition, such as the mPFC, precuneus, and hippocampus (Sherman, Payton, Hernandez, Greenfield, & Dapretto, 2016). Taken together, these findings suggest that adolescents' orientation toward social media, with its opportunities for peer interaction and feedback, may be partially driven by developmental changes at the neurobiological level.

These aspects of adolescence and features of social media platforms create a confluence of factors that may contribute to adolescent depression. Although research on the psychological effects of social media use for all age groups is burgeoning, a particular focus on adolescence is warranted. Youth in this developmental period may be uniquely vulnerable to aspects of social media use, particularly the focus on images. It is imperative that researchers understand how

different experiences on social media may lead to negative mental health consequences for adolescents.

1.2 Time Spent on Social Media and Depressive Symptoms

A number of different methodological approaches have been employed to investigate the relationship between time spent on social media and depressive symptoms, finding a positive—though complicated—relationship. Using generational data, some find a sharp uptick in depressive symptoms and suicide rates for adolescents, especially among females, after 2010—the same year that smartphones and social media were becoming widely used (Twenge, Joiner, Rogers, & Martin, 2017). This relationship persists when controlling for indicators of national economic changes, such as rates of unemployment or shifts in the stock market (Twenge, Martin, & Campbell, 2018).

Studies from adolescent samples in Canada (Sampasa-Kanyinga & Lewis, 2015), Europe (Tsitsika et al., 2014), and China (Yan et al., 2017) find associations between heavy social media use (i.e., spending 2 hours or more on social networking sites per day) and greater internalizing problems. Importantly, however, other studies find no effects (e.g., Banjanin, Banjanin, Dimitrijevic, & Pantic, 2015; Neira & Barber, 2014). Yet these studies reporting null results find that when social media use is subjectively defined as "excessive" based on intrusions upon daily life functioning (e.g., inability to get off social media when intended), rather than quantity or frequency of social media use, a link to adolescent mental health emerges (Banjanin et al., 2015; Neira & Barber, 2014). These mixed results suggest that time spent on social media may be an important factor in predicting depressive symptoms, but the subjective nature of social media use may be equally or more important.

Although experimental findings are sparse, several experiments conducted with adult participants support a relationship between social media use and mental health. The few lab-based studies conducted found that adults assigned to use Facebook during their lab visit subsequently reported more negative mood than those who spent time on a non-social media control website (Fardouly, Diedrichs, Vartanian, & Halliwell, 2015; Yuen et al., 2018). Field-based experimental studies found that adults assigned to limit their social media use to 10 minutes per day for a month (Hunt, Marx, Lipson, & Young, 2018) or to take a break from Facebook altogether for a week (Tromholt, 2016) reported better psychological well-being. To date, only one pseudo-experimental study has focused on adolescents, finding that early adolescents whose parents limited their social media use reported better mental health than their peers who used social media with no time restrictions (Fardouly, Magson, Johnco, Oar, & Rapee, 2018).

Longitudinal research further supports these claims of social media use preceding mental health effects. Although findings are still not straightforward and many effects are small, a number of studies using adolescent samples find greater social media use predicts worse mental health over time (Coyne et al., 2018; Houghton et al., 2018). Other longitudinal studies find similar results initially, but determine the relationship to be ultimately not significant when controlling for demographic and other relevant covariates (Heffer et al., 2019; van der Velden et al., 2019).

Notably, some studies have found a positive relationship between social media use and well-being—though this relationship, too, appears complex. Scholars argue that, given certain circumstances, social media may aid adolescents' perceptions of social support, experience of identity exploration, and opportunities for self-disclosure (Best, Manktelow, & Taylor, 2014). One study found that adolescents who communicated directly with friends on social media reported better outcomes, in part because of the benefits to their offline relationships (Valkenburg & Peter,

2007), and another found that adolescents who reported having online social support networks experienced less psychological distress with more time spent on social media (O'Dea & Campbell, 2011). Importantly, the potential benefits of social media for adolescent development likely depend on a number of factors, including the valence of the online experiences and one's offline social relationships (Abbas & Mesch, 2018; Shapiro & Margolin, 2014).

Theories of depression in adolescence provide a framework through which to understand the link between social media use and depressive symptoms. Cognitive theories of depression contend that distorted, overly negative thinking contributes to depressive symptoms (Beck, 2002). These distortions include overgeneralizing, thinking in black and white terms, catastrophizing, selective thinking, and blaming oneself for negative experiences (Beck, 1963). Cognitive distortions in the context of social media, which gives adolescents unprecedented opportunities to reflect on themselves and how others view them, may lead to increased depressive symptoms. For example, these cognitive tendencies may lead adolescents to draw negative conclusions from ambiguous online interactions, attend only to negative self-referential online content, or fixate on their physical appearance in social media photos. In fact, empirical evidence with college students suggests that the negative mental health outcomes associated with appearance comparisons on social media are exacerbated by appearance-focused cognitive distortions, such as the belief that one's physical appearance is integral to achieving future goals or focusing excessively on perceived deficits in one's appearance (Ridolfi, Myers, Crowther, & Ciesla, 2011).

Furthermore, interpersonal theories of depression state that depressed youth display interpersonal deficits, such as excessive reassurance-seeking, and experience disruptions in their social relationships, such as conflict and rejection (Rudolph, Flynn, & Abaied, 2008). Heightened attention to peers and social interactions in adolescence increases vulnerability to such experiences

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and intensifies the link between interpersonal difficulties and depressive symptoms (Rudolph et al., 2008). The maladaptive interpersonal tendencies of depressed adolescents may be exacerbated in the context of social media. For example, teens can seek and fail to attain reassurance through quantifiable metrics of peer approval. They may also experience conflict and rejection in potentially more harmful ways, including as an ever-present experience via the availability of social media or through public humiliation given their widespread online networks. Furthermore, neurological changes in adolescence, including heightened self- and social-processing systems, predispose adolescents to care more about information related to oneself and the social world (Crone & Dahl, 2012), potentially aggravating the interpersonal factors of social media use that lead to depression during this developmental period.

Theories about gender differences in depression are also relevant. The majority of studies investigating the influence of social media on depressive symptoms finds that girls are at greater risk than boys (McCrae et al., 2017; Orben, Dienlin, & Przybylski, 2019; Simoncic, Kuhlman, Vargas, Houchins, & Lopez-Duran, 2014; Twenge et al., 2017). Girls are far more likely to experience greater internalizing symptoms, including depressive symptoms, compared to boys (Chaplin & Aldao, 2013), with lifetime prevalence rates of major depressive disorder among women nearly twice that of men (Kessler et al., 2003). This disparity emerges during adolescence, when girls are socialized to take on feminine traits that predispose them to depressive symptoms (Hill & Lynch, 1983; Nolen-Hoeksema & Girgus, 1994). These tendencies include basing one's self-worth on social relationships, coping with stress passively via rumination, and reduced self-confidence and feelings of effectiveness (Nolen-Hoeksema & Girgus, 1994). Interpersonal theories of depression highlight girls' heightened sensitivity to social stressors, and the increase in interpersonal stress in adolescence, as contributing to their increased depressive symptoms

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(Rudolph, 2002). This vulnerability to social stress, paired with a tendency towards rumination, may make negative social media experiences particularly harmful for adolescent girls, as they have greater opportunities to reflect on their online presentation and experience conflict or rejection online.

Taken together, these theories support results suggesting that there is a relationship between time spent on social media and mental health, yet other factors are necessary to consider in order to fully understand this relationship. Researchers who argue that parents and policy makers must seek to simply reduce the amount of time young people spend on social media frequently meet opposition from other scholars, who argue for a more nuanced approach to this issue (see Marino, 2018). The complexity of the aforementioned findings regarding time on social media has led to a focus on the particular aspects of or experiences on social media that may better explain its relationship to depressive symptoms.

1.3 Aspects of Social Media Linked to Depressive Symptoms

Scholars seeking to identify which aspects of social media use are most closely linked to negative outcomes have investigated specific *features* of social media platforms, the particular *behaviors* adolescents engage in on these platforms, and the *subjective experience* reported by adolescents using these platforms. Many of these studies consider how these features or behaviors themselves affect mental health outcomes, while others try to identify how these aspects of social media may mediate or exacerbate the relationship between time spent on social media and ensuing depressive symptoms.

Several studies have sought to examine how specific *features* of some social media sites impact adolescent mental health. One study focused specifically on adolescents' use of highly-visual social media (HVSM; e.g., Instagram, Snapchat, and Facebook), and found that adolescents who used HVSM for more than two hours a day reported more internalizing problems than their peers (Marengo et al., 2018). A study of emerging adults found that those who frequently visited only creative sites (e.g., Vine and Tumblr) were less likely to experience depression than those considered high social media users across platforms (Ilakkuvan, Johnson, Villanti, Evans, & Turner, 2019), suggesting that particular aspects of these platforms may explain some of the negative effects of heavy social media use.

The specific *behaviors* enacted on social media, including passive scrolling, frequent checking for updates, or posting "selfies," are in many ways unique to social media experiences due to the visual, permanent, public, and quantifiable aspects of social media (Nesi et al., 2018). Passive social media use, including scrolling through posts without direct communication with others, has been shown to predict worse mental health outcomes over time for young adults and female adolescents (Aalbers, McNally, Heeren, de Wit, & Fried, 2018; Frison & Eggermont, 2016). Frequency of checking social media for updates, including for "likes" on one's content, has been linked to greater depressive symptoms for adolescents (Barry, Sidoti, Briggs, Reiter, & Lindsey, 2017). Compared to general social media use, more "selfie" activity (i.e., taking and posting photos of the self), including investment in the number of "likes" on one's posted selfie and manipulating the photo through editing techniques, may be associated with greater internalization of the thin ideal, body dissatisfaction, and disordered eating for adolescent girls (McLean et al., 2015).

The features of social media or specific behaviors enacted on social media platforms could conceivably lead to different outcomes depending on how adolescents *subjectively experience* their time on social media. Some general psychological tendencies, including social comparison and rumination, have been implicated as potential explanations of the relationship between social media and mental health (Baker & Algorta, 2016). For adolescents, social comparison was found to mediate the impact of Instagram use (Lup, Trub, & Rosenthal, 2015) and Facebook use (Steers, Wickham, & Acitelli, 2014) on depression. Rumination in part explained the relationship between posting on Facebook and depression for young adults (Locatelli, Kluwe, & Bryant, 2012). Furthermore, college students who made social comparisons on Facebook, when controlling for general tendency for social comparison, experienced greater depressive symptoms in part because of increased rumination (Feinstein et al., 2013). Although social comparison and rumination likely help explain the relationship between social media use and mental health, the way social media fundamentally alters online experiences requires consideration of entirely new subjective experiences online.

A few studies have proposed and examined psychological constructs unique to social media as potential explanations of its effects. For example, excessive attachment or addiction to social media (e.g., *Facebook addiction*, Andreassen, Torsheim, Brunborg, & Pallesen, 2012; *Facebook intrusion*, Elphinston & Noller, 2011) has been linked to depression (Blachnio, Przepiorka, & Pantic, 2015). However, the visual nature of social media, paired with the societal emphasis on physical attractiveness, may create a distinctive psychological experience related to the preoccupation with appearance on social media. Preliminary work on ASMC is among the first to investigate how thoughts about one's own presentation on social media may create a unique pathway through which social media could negatively impact mental health, particularly for

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adolescents (Choukas-Bradley et al., 2019; Choukas-Bradley et al., 2020). These studies present ASMC as a promising construct in explaining the effects of social media, yet longitudinal studies are necessary to further elucidate its role.

1.4 The Role of Gender

Although physical attractiveness is a universally desired trait, the role of appearance concerns in adolescence, particularly as they relate to social media use, is highly gendered. Relative to boys, adolescent girls view more appearance-focused mass media (e.g., magazines), experience greater internalization of beauty ideals, have more conversations with their friends about appearance, and engage in more appearance comparisons with peers (Jones, 2001; Jones et al., 2004). Across development, girls experience greater body dissatisfaction than boys, with increases in body dissatisfaction in part explained by appearance conversations and peer appearance comparisons (Jones, 2004).

In 1997, Fredrickson and Roberts proposed *objectification theory* as a framework for understanding how the sexualization of women in media and modern culture manifests in disproportionate negative mental health outcomes for women. The theory describes the experience of the imagined audience, arguing that girls and women are socialized to take on an observer's perspective of their bodies, resulting in *self-objectification*. This tendency to view oneself as an object, or as primarily valuable for her appearance, can increase women's perpetual monitoring of their bodies and lead to increased shame when they do not meet societal standards of beauty. Empirical studies have indeed found that the experience of self-objectification is associated with body monitoring, body shame, depression, anxiety, and disordered eating symptoms in adult

women (Harper & Tiggemann, 2007; Miner-Rubino, Twenge, & Fredrickson, 2002). Research has also identified ways in which men and boys can experience self-objectification, albeit at generally lower levels than girls and women, spurred in part by unattainable portrayals of male muscularity in media (Grieve & Helmick, 2008; Roberts & Gettman, 2004).

The experience of self-objectification is particularly pronounced for girls during the adolescent years. This is in part due to features of adolescent development, including the adolescent tendency to experience an imaginary audience (Elkind, 1967; Galanaki, 2012) and to be preoccupied with how one appears to peers (Brechwald & Prinstein, 2011). In recent decades, self-objectification in adolescents has also been spurred by increasingly sexualized representations of girls in modern media (American Psychological Association, 2007), as well as idealized and sexualized images of peers on social media (Slater & Tiggemann, 2015). As with adult samples, adolescent girls report greater self-objectification than boys, and these experiences are linked to numerous mental health consequences, including shame, disordered eating, and depressive symptoms (Grabe, Hyde, & Lindberg, 2007; Tiggemann & Slater, 2015). Longitudinal evidence further shows that gender differences in self-objectification precede girls' higher reported rates of depression, with body shame and rumination acting as mediators (Grabe et al., 2007).

These gender differences in adolescents' experiences may in part explain why girls appear to be at greater risk of negative mental health outcomes as a result of social media use. A number of studies have found gender to be a significant moderator of the relationship between social media use and depressive symptoms (McCrae et al., 2017; Orben et al., 2019; Simoncic, et al., 2014; Twenge et al., 2017), though others found no effects of gender (Banjanin et al., 2015; Barry et al., 2017). It is possible that the greater emphasis on adolescent girls' physical appearance relative to

boys (Jones et al., 2004) is exacerbated by the visual nature of social media, leading to disparities in social media's impact on mental health.

Girls do appear to engage more in the maladaptive behaviors associated with the harmful effects of social media use. Although girls use social media more than their male peers (Joiner et al., 2012), one study found that girls with a social media account had worse mental health outcomes than boys, but these effects were not explained by time spent on social media (Neira & Barber, 2014). Adolescent girls appear to be more prone to engage with the visual, appearance-focused aspects of social media, as they take more selfies (Dhir, Pallesen, Torsheim, & Andreassen, 2016) and post more photographs (Pujazon-Zazik & Park, 2010) than their male peers. The gender differences in these behaviors are likely spurred from the greater societal emphasis on appearance for girls relative to boys (Fredrickson & Roberts, 1997; Jones et al., 2004). The permanent nature of social media posts and the emphasis on photographs ensures that adolescents can habitually revisit their own and others' images to assess their attractiveness and imagine how they look to outside observers (Nesi et al., 2018), which adolescent girls may be more apt to do than their male counterparts.

This emphasis on appearance for adolescent girls may lead them not only to engage in certain appearance-related behaviors more, but also to experience these behaviors as more meaningful to their well-being and self-concept. Girls who are more invested in their social media experiences (Neira & Barber, 2014), and spend more time passively scrolling on Facebook (Frison & Eggermont, 2016), are more likely to experience depressed mood than their female peers, yet these associations are not found for boys. Adolescent girls also experienced a particularly strong relationship between depressive symptoms and both online social comparison and feedback seeking on social media (Nesi & Prinstein, 2015). Moreover, because girls are socialized to

prioritize their physical attractiveness more than boys, girls are more likely to perceive their self-worth as contingent upon their appearance, and experience greater threat and self-doubt when viewing their own and others' photos online (Fredrickson & Roberts, 1997; Stefanone, Lackaff, & Rosen, 2011). Thus, it seems that girls are not only more likely to engage in the maladaptive behaviors associated with social media use, but also may be more likely to react to these experiences in a potentially harmful way.

ASMC, which describes a pervasive awareness of one's physical appearance on social media, may be particularly important in understanding how gender and time spent on social media interact to lead to greater depressive symptoms. Specifically, the extent to which ASMC explains or alters the association between social media use and later depressive symptoms may be moderated by gender. Identifying if and how ASMC mediates or exacerbates this association differently for boys and girls may illuminate how girls may be at risk of greater depressive symptoms due to time spent on social media.

1.5 The Present Study

The current study seeks to examine how ASMC may relate both to time spent on social media and depressive symptoms for adolescents in a high school sample. ASMC, the experience of preoccupation with how one does or might appear in social media photos, has been linked to worse mental health outcomes, including symptoms of depression, in cross-sectional studies (Choukas-Bradley et al., 2019; Choukas-Bradley et al., 2020). Adolescents may be particularly vulnerable to ASMC experiences, given the value placed on peers, status, and appearance during this developmental period (Brechwald & Prinstein, 2011; Jones et al., 2004). Although a newly

proposed construct, one study found that over 90% of high school students reported some degree of ASMC experiences (Choukas-Bradley et al., 2020).

ASMC has only been found to be correlated with depressive symptoms in cross-sectional studies; therefore, longitudinal evidence is necessary to identify the temporality of this association. Previous evidence suggests that potentially harmful subjective experiences on social media, such as social comparison and rumination, precede mental health symptoms (Coyne et al., 2018; Feinstein et al., 2013; Houghton et al., 2018). Other studies have found that self-objectification, a similar experience to ASMC, precedes increases in depressive symptoms during adolescence (Grabe et al., 2007). Thus, it is likely that ASMC, too, precedes depressive symptoms.

Additionally, time spent on social media has been linked to later mental health outcomes across many studies, though the relationship is complicated—possibly due to moderating factors and competing positive and negative effects. ASMC may be an important aspect of the relationship between time spent on social media and later depressive symptoms. It is possible that as adolescents spend more time on social media, their opportunities to engage in ASMC increase, which leads to subsequently higher depressive symptoms. In a correlational study of adolescents, ASMC was uniquely associated with depressive symptoms above and beyond time spent on social media (Choukas-Bradley et al., 2020). Although many studies have sought to identify mechanisms explaining why time spent on social media may be associated with worse mental health, few have considered psychological experiences related to physical appearance, such as ASMC, that are unique to features of social media usage. Figure 1 presents a conceptual model of this proposed mediation pathway, with time on social media leading to increases in depressive symptoms via ASMC.

Alternatively, ASMC may moderate this association between time on social media and depressive symptoms, potentially explaining why some adolescents experience negative mental health symptoms as a result of using social media, while others do not. Previous research has not considered this potential function of ASMC, but studies with adults have found that social comparison on social media exacerbates the association between time on social media and depression (Lup et al., 2015; Steers et al., 2014). Although ASMC is a subjective social media experience focused on the self, rather than others, it is possible that it similarly exacerbates this link. Figure 2 presents a conceptual model of this proposed moderation model, with time on social media leading to increases in depressive symptoms for those who report high levels of ASMC. The current project seeks to use longitudinal data to identify if ASMC mediates or moderates the relationship between time spent on social media and depressive symptoms.

Furthermore, gender may be an important moderating factor in the associations between time on social media, depressive symptoms, and ASMC. Previous theory asserts that, relative to boys, girls may be particularly vulnerable to engaging in appearance-related concerns and self-objectification (Fredrickson & Roberts, 1997), and girls' feelings of self-worth may be more contingent on their appearance (Stefanone et al., 2011). In line with previous work, adolescent girls and emerging adult women reported significantly higher levels of ASMC (Choukas-Bradley et al., 2019; Choukas-Bradley et al., 2020). Studies have also shown that the relationship between time on social media and depression is particularly strong for girls (McCrae et al., 2017). It is therefore likely that, whether ASMC mediates or moderates the link between time spent on social media and depressive symptoms, gender will alter the effects of ASMC.

In a recent cross-sectional study, however, significant differences in the association between ASMC experiences and depression for adolescent boys and girls were not observed

(Choukas-Bradley et al., 2020). This result is puzzling, given that theory and prior empirical work predict that appearance-related concerns and self-objectification are associated with worse mental health outcomes for girls relative to boys (Fredrickson & Roberts, 1997; Grabe et al., 2007; Stefanone et al., 2011). Although both boys and girls likely experience negative effects related to ASMC, adolescent girls are socialized to prioritize their appearance more than boys, and thus ASMC experiences may be particularly potent and meaningful for girls compared to boys (Fredrickson & Roberts, 1997; Stefanone et al., 2011). Given the conflicting evidence presented by previous work and theory, more research is necessary to investigate the moderating role of gender on the association between ASMC and depressive symptoms. Figures 3 and 4 depict conceptual models of gender as a moderator of all pathways of the proposed mediation model and as a moderator of the proposed moderation model, respectively.

The present study will investigate the following three research aims:

(1) Do higher ASMC experiences precede increases in adolescents' depressive symptoms over time?

Hypothesis 1: ASMC will be associated with adolescents' depressive symptoms one year later, controlling for gender and prior levels of depressive symptoms.

(2) Does ASMC in part explain the association between frequency of social media use and later depressive symptoms, or does it exacerbate this association? The following hypotheses are competing, with only one predicted to be true:

Hypothesis 2a: ASMC will partially mediate the association between time spent on social media and adolescents' depressive symptoms one year later.

Hypothesis 2b: ASMC will moderate the association between time spent on social media and adolescents' depressive symptoms one year later.

(3) Does the role of ASMC depend on adolescents' gender?

Hypothesis 3: Depending on whether ASMC functions as a mediator or moderator of the association between time spent on social media and adolescents' depressive symptoms one year later (H2a and H2b), gender will moderate the effects of ASMC.

If the mediation model (H2a) is supported, gender will be expected to moderate the mediation model of time spent on social media and adolescents' depressive symptoms one year later, via ASMC. Specifically, the association between time spent on social media and ASMC will be stronger for girls. The moderating role of gender on the association between ASMC and later depressive symptoms will also be explored. Given the conflicting evidence from prior studies discussed previously, it is possible that the association between ASMC and depressive symptoms will be stronger for girls; alternatively, it is possible that gender will not moderate the association between ASMC and depressive symptoms. Alternatively, if the moderation model (H2b) is supported, a three-way interaction between time spent on social media, ASMC, and gender will be expected to significantly predict depressive symptoms, such that girls high in ASMC who use social media more will experience the greatest subsequent depressive symptoms.

2.0 Method

2.1 Participants

Data for the current study were collected as part of a broader study focused on adolescents' technology use, body image, sexual health, and mental health. Participants (n = 163, 55.8% female) were surveyed in their high school classrooms in the Southeastern USA. The initial survey (T1) was conducted in the spring of 2018. Approximately two weeks later, an intervention was administered (not relevant to the current study; see below). Follow-up surveys were administered one year after T1, in the spring of 2019. For parsimony, the one-year follow-up is referred to as "T2" in this proposal. At baseline, participants ranged in age from 15 to 18 (M = 16.19, SD = 0.76). The sample was racially/ethnically diverse (50.9% White, 24.5% Black, 28.2% Hispanic, 2.5% Asian, and 1.8% other race or ethnicity) and socioeconomically diverse (49.7% report receiving free or reduced-price lunch). The majority (79.8%) identified as exclusively heterosexual.

A power analysis conducted with G*Power 3.1.9.4 (Faul, Erdfelder, Buchner, & Lang, 2009) indicated that a sample of 163 would be sufficiently powered ($1-\beta$ = .99) to detect a medium effect (f_2 = .15) for linear multiple regression analyses with four predictor variables. A previous correlational study examining the impact of ASMC, gender, and time spent on social media on depression found a medium effect among adolescents (f_2 = .16; Choukas-Bradley et al., 2020).

2.2 Procedure

At baseline, all students in grades 10 and 11 ($n = 754$) were recruited by research assistants at one school in a rural county in the Southeast. Due to the nature of some survey items, active consent by parents was required. Students were offered small prizes for returning signed consent forms, regardless of their parents' decision. Of the total forms returned ($n = 309$), 76.7% ($n = 237$) provided parental consent to participate and 5% ($n = 11$) of these students did not complete baseline assessments due to absence, school withdrawal, or choosing not to participate. The final sample at baseline included 226 adolescents. Similar recruitment procedures were conducted at the one-year follow up, with 72.1% ($n = 163$) of the original sample retained.

At both baseline and the one-year follow-up, students completed surveys on Qualtrics using laptop computers with privatizing dividers. All students provided written assent before participating in the study. Students received a $10 gift card for participating in the baseline survey, and another $10 for participating in the one-year follow-up.

The data for the present study were collected as part of a larger longitudinal intervention study examining the efficacy of sexual health and academic mindset interventions. The first intervention presented information on sexually transmitted disease prevention, such as contraceptive use (see Widman, Golin, Kamke, Burnette, & Prinstein, 2018), while the second sought to foster a growth, rather than fixed, academic mindset (see Burnette, Russell, Hoyt, Orvidas, & Widman, 2018). Neither previous theory nor empirical work suggests that content from either intervention should alter time spent on social media, ASMC, or depressive symptoms. Independent samples *t*-tests were run to analyze differences between groups on all T2 study variables. No significant differences were found between intervention groups for social media use ($p = .31$), ASMC ($p = .87$), or depressive symptoms ($p = .85$). A sensitivity analysis, as described

in the data analytic plan, will consider the effect of including intervention condition as a covariate in all analyses

2.3 Measures

Measures for this study will include demographic questions as well as measures of time spent on social media, ASMC, and depressive symptoms.

Demographic Questions. One question each (asked at T1) was used to assess race, gender (options include "girl," "boy," or "transgender or other gender identity"), and sexual orientation identity. One question (asked at T1) was used to assess socioeconomic status, asking if participants received free or reduced-price lunch at school that year.

Social Media Use. Frequency of social media use was assessed with one question, asking students to report how much time, on a typical day, they spend using any social media. Responses were on a 11-point Likert scale (0 = *Less than 1 hour* to 10 = *10 or more hours*).

Appearance-Related Social Media Consciousness. ASMC was assessed with a recently developed instrument (Choukas-Bradley et al., 2020) that measures individuals' thoughts and behaviors related to an ongoing awareness of their physical appearance on social media. Example items include "I try to guess how people on social media will react to my physical appearance in my pictures," and "My attractiveness in pictures is more important than anything else I do on social media." Respondents report the frequency of each stated experience on photo-based social media platforms (e.g., Facebook, Snapchat, and Instagram), on a 7-point Likert scale (1 = *Never* to 7 = *Always*). See Appendix for the full ASMC scale. Participants responded to the same measure at T1 and T2. Prior work has demonstrated the internal consistency, convergent and incremental

validity, and test-retest reliability of ASMC scores in high school samples (Choukas-Bradley et al., 2020). Internal consistency was good in the current sample at T1 ($\alpha = .92$) and at T2 ($\alpha = .93$).

Depressive Symptoms. Symptoms of depression were assessed with the Short Mood and Feelings Questionnaire (Sharp, Goodyer, & Croudace, 2006) administered at T1 and T2. Participants were asked to respond to feelings and experiences, reporting how much they have felt each way in the past two weeks. Responses were on a 3-point Likert scale (0 = *not true* to 2 = *true*). Sample items include "I felt miserable or unhappy" and "I felt I was a bad person." The SMFQ is a valid measure to assess depressive symptom severity in late adolescence (Turner, Joinson, Peters, Wiles, & Lewis, 2014). Internal consistency was good at T1 ($\alpha = .93$) and at T2 ($\alpha = .91$).

3.0 Data Analytic Plan

Before testing the main hypotheses, I determined descriptive statistics of study variables, including differences between boys and girls and bivariate correlations of all measures at both time points. I also compared participants who completed measures at T1 but not T2, to examine differences between these students on any study variables.

To test hypothesis 1, that ASMC would predict greater depressive symptoms over time, I conducted a multiple linear regression. The model included ASMC at T1 as the independent variable, controlling for depressive symptoms at T1 and gender, with depressive symptoms at T2 as the dependent variable.

To test hypothesis 2a, that ASMC would mediate the relationship between time spent on social media and depressive symptoms, I conducted a mediation model. The product of two multiple linear regression models, assessing the effect of the independent variable on the mediator and the mediator on the dependent variable, determined the strength of the indirect effect (Hayes, 2009). With gender and baseline depressive symptoms as covariates, the independent variable was time spent on social media at T1, the mediator was ASMC at T1, and the dependent variable was depressive symptoms at T2. See Figure 1 for a conceptual diagram. Linear regressions were used to establish the A-path (time on social media predicting ASMC, controlling for gender and depressive symptoms at T1), B-path (ASMC at T1 predicting depressive symptoms at T2, controlling for time on social media at T1, gender and depressive symptoms at T1), and C-path (time on social media at T1 predicting depressive symptoms at T2, controlling for ASMC at T1, gender and depressive symptoms at T1).

The significance of the indirect effect, or the AB path, was calculated using nonparametric bootstrap resampling of 20,000 samples (Mackinnon, Lockwood, & Williams, 2004). Bootstrapping methods for attaining confidence intervals are more highly powered than other techniques (e.g., the causal steps approach) and, unlike other tests, require no assumption of normality in the sampling distribution of the indirect effect (e.g., Sobel test; Hayes, 2009).

To test hypothesis 2b, that ASMC would moderate the association between time spent on social media and depressive symptoms, I conducted a multiple linear regression. The model included time spent on social media at T1, ASMC at T1, and the interaction between time spent on social media and ASMC as the independent variables, controlling for depressive symptoms at T1 and gender, with depressive symptoms at T2 as the dependent variable. See Figure 2 for a conceptual model.

As an extension of hypothesis 2a, the model with ASMC as a mediator of the association between time spent on social media and depressive symptoms, I examined the role of gender as a moderator of that model with a moderated mediation model (Preacher, Rucker, & Hayes, 2007). Moderated mediation models can be tested with the same nonparametric bootstrapped sampling distribution as described above. The linear regression analyses were conducted as previously stated, with the inclusion of gender moderating all paths. See Figure 3 for a conceptual model. While controlling for depression at T1 for each linear regression, interaction terms between time spent on social media and gender were included in predicting both ASMC at T1 (A-path) and depressive symptoms (C-path). An interaction term between ASMC and gender was included in predicting depressive symptoms (B-path), also controlling for depressive symptoms at T1. The confidence interval for the conditional indirect effect was assessed using the same bootstrapping method of 20,000 samples as described above (Mackinnon et al., 2004; Preacher et al., 2007).

As an extension of hypothesis 2b, the model with ASMC as a moderator of the association between time spent on social media and depressive symptoms, I examined the role of gender as a moderator of that model with a moderated multiple regression. The model included time spent on social media at T1, ASMC at T1, and gender as independent variables, as well as the two-way interactions between each possible pair of these variables and the three-way interaction between all three variables. The model also controlled for depressive symptoms at T1 with depressive symptoms at T2 as the dependent variable. See Figure 4 for a conceptual model.

To rule out the possibility that intervention condition affected the main analyses, I conducted a sensitivity analysis including intervention condition as a covariate for all models. This approach maintained statistical power and increased the chances of finding a small effect by limiting the number of unnecessary covariates. Power analyses conducted in G*Power 3.1.9.4 (Faul et al., 2009) indicate that including intervention condition as a covariate allowed detection of effects no smaller than $f_2 = 0.09$ with sufficient power ($1- \beta = .80$) for the analysis with the most predictors, while dropping intervention condition as a covariate allowed for detection of effects as small as $f_2 = 0.08$ for the same analysis.

4.0 Results

Descriptive statistics for all study variables for the total sample and by gender are shown in Table 1. Girls reported higher overall ASMC, time spent on social media, and depressive symptoms at both T1 and T2 compared to boys. Bivariate correlations for study variables at both time points are presented, by gender, in Table 2.

Comparisons were also made between the participants who completed both time-points and those who did not. There were no differences across groups on ASMC at T1 ($p = .50$), depressive symptoms at T1 ($p = .60$), or time spent on social media at T1 ($p = .20$). Although there were more girls at both time-points than boys, a significantly greater proportion of boys (80%) completed both T1 and T2 compared to girls (69%, $p < .001$).

As stated above, independent samples t-tests by intervention condition (i.e., sexual communication intervention or academic mindset intervention) showed no difference between groups for time on social media at T2 ($p = .31$), ASMC at T2 ($p = .87$), or depressive symptoms at T2 ($p = .85$). All models described below initially included intervention condition as a covariate. In all cases, condition was not a significant predictor of depressive symptoms (ps $= .15$ to $.18$). The same pattern of results was found for the key study variables in all models with and without intervention condition as a covariate, and thus intervention condition was dropped from the reported analyses below to retain statistical power.

Two multiple linear regression models were run to evaluate the unique association between ASMC at T1 and depressive symptoms at T2 and between time spent on social media at T1 and depressive symptoms at T2, both controlling for gender and depressive symptoms at T1. The model with ASMC at T1 as the predictor was significant, $R_2 = 0.45$, $F(3, 159) = 44.56$, $p < .001$.

ASMC significantly predicted later depressive symptoms ($\beta = 0.18$, $p = .01$), whereas gender was not a significant predictor ($\beta = -.03$, $p = .68$). A separate multiple linear regression model was run to assess the role of time spent on social media at T1 on later depressive symptoms, controlling for gender and depressive symptoms at T1. The model was again significant, $R_2 = 0.44$, $F(3, 159) = 43.34$, $p < .001$. Time spent on social media significantly predicted later depressive symptoms ($\beta = 0.13$, $p = .04$), whereas gender was again not a significant predictor ($\beta = -.06$, $p = .35$).

A third model was run including both ASMC at T1 and time on social media at T1 as predictors of depressive symptoms at T2, controlling for gender and depressive symptoms at T1. This model was significant, $R_2 = 0.45$, $F(4, 158) = 34.12$, $p < .001$. Time spent on social media was not significantly associated with later depressive symptoms ($\beta = 0.09$, $p = .16$), whereas ASMC was ($\beta = .14$, $p = .047$). Multicollinearity diagnostic tests were run to ensure correlations between ASMC and time spent on social media did not undermine the significance of the other variable to explain variance in depressive symptoms at T2. The average Variance Inflation Factor (VIF) across all four predictors was 1.31, suggesting that collinearity was low in this model (Thompson, Kim, Aloe, & Becker, 2017).

Competing models were then tested to investigate whether ASMC may mediate or moderate the association between time spent on social media and later depressive symptoms. To address hypothesis 2a, a mediation model considered the effect of time spent on social media at T1 on depressive symptoms at T2 via ASMC at T1, controlling for gender and depressive symptoms at T1. The indirect effect (AB path) approached significance but did not meet traditional definitions of statistical significance, b = .006, 95% CI [-.0004, .01]. Coefficients for key pathways are presented in Figure 5. All model statistics are presented in Table 3. To address hypothesis 2b, a moderated linear regression model considered if the effect of time spent on social media at T1

on depressive symptoms at T2 changed as a function of ASMC at T1, controlling for gender and depressive symptoms at T1. The interaction between ASMC at T1 and time on social media at T1 in this model was non-significant, $b = -.003$, $p = .67$. See Table 4 for complete model statistics.

Given that ASMC was not found to mediate or moderate the association between time spent on social media and later depressive symptoms, the moderating effect of gender on these models, as outlined in hypotheses 3a and 3b, was considered for both. Probing for a gender interaction in the absence of a main effect is appropriate, as cases of cross-over interactions may mask the main effects of the predictor variables (Levine & Cruz, 1991). First, the effect of gender as a moderator on all pathways of the model with ASMC as a mediator was examined (hypothesis 3a). Gender did not moderate the A-path, $b = -.06$, 95% CI [-.19, .06], the B-path, $b = -.06$, 95% CI [-.004, .11], or the C'-path, $b = .02$, 95% CI [-.03, .06]. The conditional indirect effect, or the difference in indirect effects (AB-path) between girls and boys, was also not significant, $b = -.01$, 95% CI [-.02, .004]. See Figure 6 for coefficients of key pathways and Table 3 for all model statistics. Second, the three-way interaction between gender, time on social media, and ASMC was evaluated to test for gender moderation in the model with ASMC as a moderator (hypothesis 3b). The three-way interaction was not significant, $b = .03$, $p = .10$. See Table 4 for complete model statistics.

Finally, although the conditional indirect effect was not significant in the prior moderated mediation or three-way interaction models, models examining the role of ASMC as a moderator and mediator of the association between time on social media and later depressive symptoms were conducted separately for boys and girls. It is possible that, although the interaction effect or indirect effect for the two groups did not differ significantly from each other, the interaction or mediation model may differ significantly from zero for one group but not the other. In the moderation model split by gender, the interaction between time on social media and ASMC was not significant among

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boys (β = 0.34, *p* = .24) or among girls (β = -0.43, *p* = .16). In the mediation model split by gender, the indirect effect among boys only was not significant, b = .0006, 95% CI [-.007, .009]. Among girls, however, the indirect effect was significant, b = .01, 95% CI [.001, .03].

A post-hoc Monte Carlo power analysis was conducted to determine the possibility of having found an indirect effect among boys only (*n* = 72; Shoemann, Boulton, & Short, 2017). The model was replicated 10,000 times with 20,000 Monte Carlo draws per replication. The mediation model with boys achieved 5% power (1 - β = 0.05) to detect an indirect effect of the magnitude found (b = .0006). In contrast, the model with girls (*n* = 91) achieved 93% power (1 - β = 0.93) to detect an indirect effect of the magnitude found (b = .01). Thus, it is possible that a significant indirect effect among boys may have been found in a larger sample.

An alternate model was run to examine if instead time on social media at T1 mediates the association between ASMC at T1 and depressive symptoms at T2 for girls. The indirect effect for this model was not significant (b = .007, 95% CI [-.02, .03]), suggesting that the originally hypothesized direction of effects is more likely than this alternate model.

5.0 Discussion

Prior work on adolescent social media use and depressive symptoms suggests a complicated association—one not fully accounted for when simply measuring frequency of social media use. The present study is in line with the burgeoning research emphasis on subjective social media experiences to explain adolescent mental health outcomes, especially for girls. Many of the key motivators during the adolescent period, including a drive for status, importance of peers, and focus on physical appearance, as well as the distinctive features of social media platforms, including visualness and quantifiable peer feedback, may intersect to contribute to adolescent depressive symptoms. Adolescent girls may be especially vulnerable to these outcomes, given the sociocultural emphasis on girls' physical appearance and increased interpersonal sensitivity. ASMC is a unique social media-based subjective experience that may help explain the association between highly-visual social media use and depressive symptoms for adolescents, especially girls.

As hypothesized, ASMC was longitudinally associated with depressive symptoms one year later. This association was maintained after controlling for time spent on social media, suggesting that the subjective experience of ASMC may contribute more to adolescent depressive symptoms than mere frequency of social media use. The results of the present study support prior cross-sectional work that ASMC is uniquely associated with adolescents' depressive symptoms above and beyond frequency of social media use (Choukas-Bradley et al., 2019). The present study also supports previous work that found subjective experiences on social media to be particularly important in predicting later mental health outcomes (Blachnio et al., 2015; Lup et al., 2015; Steers et al., 2014). Notably, both ASMC and depressive symptoms were significantly higher among girls in this sample than among boys, which is also consistent with prior work (Chaplin & Aldao, 2013;

Choukas-Bradley et al., 2019). However, ASMC was associated with later depressive symptoms when controlling for gender, and gender did not alter the effects of ASMC on later depressive symptoms in the moderated mediation model, suggesting that ASMC has a negative effect on later depressive symptoms for both adolescent boys and girls.

The present study also found that, among girls in this sample, the association between time on social media and later depressive symptoms was mediated by ASMC. This finding contributes to our understanding of the mechanistic processes by which social media use affects mental health (Baker & Algorta, 2016) and underscores the importance of investigating the psychological experience of using social media, especially concerns related to physical appearance, as driving this association (e.g., Marengo, Longobardi, Fabris, & Settanni, 2018). Adolescents girls' preoccupation with and concern about their appearance have long contributed to their mental health problems (Smolak, 2012), and these concerns and their ensuing negative consequences may be exacerbated in the era of social media. Importantly, the current analyses did not find evidence for the alternate model, that ASMC increases later depressive symptoms via time spent on social media. These null results imply that ASMC is more likely the result of spending time on social media, rather than the impetus for increased social media use. This is consistent with longitudinal work finding that appearance-focused social media use precedes adolescents' later self-objectification (Vandenbosch & Eggermont, 2015) and body dissatisfaction (de Vries, Peter, de Graaf, & Nikken, 2016), rather than vice-versa. Taken together, these results suggest that the negative impact of increased social media use, at least for young women, may be better explained by subsequent increases in maladaptive ASMC experiences.

The role of ASMC as a mediator in the pathway from time spent on social media to later depressive symptoms was not found among boys in this sample, nor was the mediation model

moderated by gender. These results suggest that the indirect effect of time on social media affecting later depressive symptoms through ASMC is not significantly different for girls and boys, though the indirect effect among boys is also not significantly different from zero. The very small indirect effect found among the sub-sample of boys, as well as the smaller sample size of boys compared to girls, likely explains these results. It is possible that this indirect effect exists in the population for boys, though to a smaller degree relative to girls. If true, a larger sample of boys would be needed to detect the smaller effect. This interpretation of the findings is supported by a prior cross-sectional study that found the link between ASMC and depressive symptoms was similar for both boys and girls (Choukas-Bradley et al., 2019). Additionally, previous work has shown that, despite the fact that girls report greater appearance concerns than boys, boys are not free of these concerns (Jones et al., 2004), and appearance concerns for boys are similarly exacerbated by media exposure as they are for girls (Slater & Tiggemann, 2014). Although boys may be slightly less vulnerable to ASMC and its ensuing negative consequences, the effect of social media and appearance concerns on boys requires further investigation.

It is also possible that the null result among boys reflects a true lack of effect in the population. This possibility is tenable, given that boys are at lower risk for depressive symptomology than girls generally (Chaplin & Aldao, 2013). This disparity is likely due in part to girls' greater interpersonal sensitivity and tendency towards rumination (Nolen-Hoeksema & Girgus, 1994; Rudolph, 2002), traits which may also predispose girls to ASMC. Indeed, adolescent boys report lower levels of ASMC (Choukas-Bradley et al., 2020) and experience less depressive symptoms as a result of using social media than their female peers (e.g., Orben et al., 2019). Boys are also less likely to use highly-visual social media platforms that focus on appearance (NORC, 2016; Anderson & Jiang, 2018), and thus may have fewer opportunities to engage in ASMC.

Additionally, boys' experiences of appearance concerns are often considered less detrimental to their mental health than those of girls. For example, among adolescents who indicate that their bodily appearance is highly important to them, only girls report heightened depressive symptoms (Murray, Rieger, & Byrne, 2018), perhaps because physical appearance is less emphasized in society for young men compared to young women (Jones, 2004). Thus, it is possible that, even if adolescent boys do experience increased ASMC as a result of social media use, the mental health consequences of ASMC are less severe than for girls.

This study proposed two competing hypotheses, finding support for a mediational model of the role of ASMC in adolescent girls' social media use and subsequent depressive symptomology. The alternate hypothesis, that ASMC would moderate the effect of time spent on social media on later depressive symptoms, was not supported in the present sample. Some prior work would suggest that ASMC should moderate this association, given that other subjective experiences, such as social comparison, exacerbated the link between Facebook use and depressive symptoms among college students (Feinstein et al., 2013). However, the present study suggests that ASMC is more likely to stem from social media exposure, rather than alter its effects. Unlike general psychological tendencies such as social comparison, adolescents must first engage with social media in order for ASMC experiences (e.g., *I try to guess how people on social media will react to my physical appearance in my pictures;* Choukas-Bradley et al., 2020) to be relevant. Additionally, as adolescents spend more time on social media, the emphasis on physical appearance, especially for girls on highly-visual social media platforms, may become increasingly apparent and important. An abundance of prior theoretical and empirical literature supports the result that appearance-focused self-perceptions and cognitions result from media exposure (e.g., Fredrickson & Roberts, 1997; Perloff, 2014; Fardouly, Wilberger, & Vartanian, 2018). Future

research should use at least three time-points to further elucidate the temporal nature of the associations among time on social media, ASMC, and depressive symptoms, and also investigate how individual differences, such as one's tendency to be invested in physical appearance or peer group norms, may alter this association.

5.1 Limitations & Future Directions

Future work should build on the limitations of this important preliminary study. First, clear limitations exist with the sample. Most notably, the present sample, especially the subsample of boys, was small. Post-hoc power analyses determined that, given the small indirect effect size among boys, it is likely that the sample was underpowered to find an effect of that degree. Furthermore, the data come from a single school in a low-income, rural Southeastern U.S. county. This population is important to understand, given that lower socioeconomic status is associated with increased risk of adolescent depression (Goodman, Slap, & Huang, 2003) as well as increased use of some highly visual social media sites (e.g., Facebook; Anderson & Jiang, 2018). The current sample was also diverse in terms of racial/ethnic identity. However, the present results may not apply to all adolescents across the United States or elsewhere. Future work should increasingly consider how other minority identities (e.g., transgender identity, disability status) and additional contextual factors (e.g., urbanicity, political climate, family structure) may impact the current results. To ensure generalizability, future work should recruit a large sample of adolescents from various geographic and demographic backgrounds to replicate these findings.

This study also used exclusively self-report data, which may have allowed for misreporting or biases in responding. Prior work has shown that, as compared to objective measures obtained

via phone data, individuals struggle to accurately report their frequency of cell phone and internet use (Scharkow, 2016). Adolescents may have misreported their time spent on social media, potentially confounding this variable with their subjective experiences on social media, such as ASMC. Future work should use rapidly improving phone technologies to objectively assess if frequency of social media use, including general use and specific use of highly-visual social media platforms, impacts ASMC. Additionally, gender biases exist in tendencies for adolescents to self-report gendered behavior to match prescriptive gender stereotypes (e.g., boys overreport and girls underreport sexual behavior; Siegel et al., 1998). Stereotypes about physical appearance in American society prescribe that women should pay attention to their appearance, while men should not care what they look like (Frith & Gleesen, 2004; Prentice & Carranza, 2002). It is possible that boys underreported and girls overreported their ASMC experiences to fit these stereotypes. Measures were taken by the research team during data collection to mitigate these biases, such as using privatizing dividers between respondents and providing verbal assurances that only researchers would see responses. Future work should consider adding other methodologies to bolster self-report measures, such as using eye-tracking as a biobehavioral marker of ASMC while participants view their own social media photographs.

5.2 Implications

When social media first became popular, researchers understandably sought to identify how increased time on these platforms may lead to mental health problems. However, the debate in the literature remains primarily focused on frequency of use, with limited attention only recently turning towards the psychological experience of social media use (Marino, 2018). The present

study poses evidence that, especially for adolescent girls, subjective experiences surrounding one's appearance and attractiveness on visual social media sites may supersede the impact of mere frequency of use. However, the current study also found that time spent on social media leads to increases in ASMC. This result suggests that calls to limit social media use (e.g., Twenge, 2017) may be beneficial for adolescents, especially girls, whose maladaptive subjective experiences related to social media may occur as a result of increased use.

Additionally, much research and public discourse remains focused on social media as a force for either "good" or "bad" (e.g., Twenge, 2017; Keating et al., 2016), neglecting the fact that the same platforms and behaviors may pose both risks and benefits depending on how adolescents use and understand them. Highly-visual social media platforms—especially when norms encourage adolescent girls to agonize over, critique, and continually perfect their online self-presentations—may pose a risk when users become overly concerned with their physical appearance (e.g., Marengo et al., 2018). These same platforms, however, may benefit others. Especially compelling is research with rural LGBT adolescents that finds those who experience isolation, discrimination, and loneliness may benefit from engaging with others online (Escobar-Viera et al., 2018). The present study contributes to the growing evidence that social media is neither a protective nor risk factor in and of itself, but rather offers benefits and risks depending on the psychological experiences associated with its use. Individual differences in pre-existing vulnerabilities (e.g., isolation as a result of identity) and the interpretation of social media use (e.g., how important aspects such as "likes" are to an individual) will be especially important to understand in the future of research on this topic.

The gender differences found in the current study suggest that the effect of both social media use and ASMC on adolescent depressive symptoms varies markedly for girls and boys. The

differences in the effects of social media use on ASMC and later depressive symptoms may be because of girls' increased valuing of physical attractiveness compared to boys (Jones et al., 204) and girls' worse negative outcomes related to appearance concerns (Slater & Tiggemann, 2010). It is important to note that the traits that make adolescent girls more prone to experience depressive symptoms (e.g., interpersonal sensitivity to stress, socially-contingent self-worth, reduced self-confidence; Rudolph, 2002; Nolen-Hoeksema & Girgus, 1994), as well as their greater concern about physical appearance relative to boys (Jones et al., 2004), likely stem from related gender socialization messages of what it means to be a woman in Western society. Parents, teachers, and clinicians should be aware of adolescent girls' increased vulnerability to focus extensively on physical appearance on social media and the potential consequences of this prioritization of online appearance. Furthermore, the present results highlight that future work on adolescent social media use must examine the differential impact of different forms of social media use on girls and boys.

Interventions may be successful in altering how adolescents experience social media. Given the developmental context of adolescence—including a burgeoning cognitive awareness of social injustice, desire for autonomy, and focus on peers—interventions to change adolescent behavior should leverage these key motivations rather than provide moralizing messages (Yeager, Dahl, & Dweck, 2018). Interventions using such an approach have already been successful in limiting adolescents' frequency of social media use (Galla, Choukas-Bradley, Fiore, & Esposito, under review). The present results indicate that interventions should also seek to alter the psychological effects of this use, potentially by reducing the value users place on physical appearance on these highly-visual platforms. Greater media literacy, including skepticism about the veracity of images portrayed in media, has been shown to buffer the negative effect of idealized social media images on young adult women (Tamplin, McLean, & Paxton, 2018). A few

preliminary social media literacy interventions with adolescent girls and young adult women have been successful in reducing body image concerns, disordered eating behaviors (McLean, Wertheim, Masters, & Paxton, 2017), and positive attitudes towards indoor tanning (Mingoia, Hutchinson, Gleaves, & Wilson, 2018). A similar approach could be used to mitigate the tendency for adolescent girls' social media use to increase ASMC and later depressive symptoms by providing education about the effects of ASMC on mental health, information about the authenticity of social media images, and broader knowledge about societal gender disparities related to the importance of physical appearance.

5.3 Conclusion

As research increasingly considers how subjective experiences on social media contribute to the rise in adolescent depressive symptoms, the effects of ASMC and the emphasis of physical appearance on these platforms, especially for girls, must be recognized. The present study presents preliminary evidence that ASMC is more important in explaining later depressive symptoms than frequency of social media use, and that the effect of frequent use influences adolescent girls' depressive symptoms in part because of increased ASMC. Future work should build on these findings to identify the many ways in which psychological experiences on social media contribute to mental and behavioral health consequences for young people. Interventions that not only limit social media use, but alter the subjective experiences of that use, could encourage healthier interactions on social media and increase adolescents' mental health and wellbeing.

Table 1. Descriptive statistics for study variables and comparisons across gender groups

	Total M (SD) $n = 16$	Girls M (SD) $n = 91$	Boys M (SD) $n = 72$	Group Comparison t (df)
ASMC T1	3.24 (1.31)	3.78 (1.24)	2.56 (1.05)	6.67 (161), $p < .001$
ASMC T2[1]	2.89 (1.45)	3.42 (1.48)	2.21 (1.09)	5.63 (151), $p < .001$
Depressive symptoms T1	0.66 (0.55)	0.78 (0.56)	0.51 (0.49)	3.20 (161), $p < .01$
Depressive symptoms T2	0.64 (0.51)	0.76 (0.50)	0.48 (0.47)	3.72 (161), $p < .001$
Time on SM T1	4.22 (2.98)	4.99 (3.11)	3.25 (2.50)	3.86 (161), $p < .001$
Time on SM T2[2]	3.20 (2.26)	3.67 (2.40)	2.60 (1.93)	3.03 (158), $p < .01$

Note. T1 = Time 1; T2 = Time 2. "ASMC" is appearance-related social media consciousness. "SM" is social media.

[1] 10 participants (5 boys and 5 girls) did not complete data regarding ASMC at T2.

[2] 3 participants (1 girl and 2 boys) did not complete data regarding time spent on social media at T2.

Table 2. Bivariate correlations among study variables

	1.	2.	3.	4.	5.	6.
1. ASMC T1	-	.77**	.34**	.42**	.37**	.47**
2. ASMC T2	.80**	-	.32**	.33**	.35**	.45**
3. Depressive Symptoms T1	.18	.09	-	.64**	.03	.30**
4. Depressive Symptoms T2	.15	.15	.62**	-	.13	.31**
5. Time on SM T1	.16	.12	-.08	.09	-	.59**
6. Time on SM T2	.25*	.15	.17	.26*	.56**	-

Note. Girls presented above the diagonal, boys below. Gender coded as 0 = girls, 1 = boys. "ASMC" is appearance-related social media consciousness. "SM" is social media.
*p < .05, **p < .01, ***p < .001

Table 3. Mediation model statistics (H2a) and moderated mediation model statistics (H3a)

Step 1: Mediation Model (H2a)	b	SE	P	95% CI
A-path				
Outcome variable: ASMC T1				
Intercept	2.70	--	--	--
Gender	-.85	.18	< .001	[-1.20, -.49]
Depressive Symptoms T1	.62	.16	< .001	[.31, .93]
Time on SM T1	.12	.03	< .001	[.31, .93]
B-path				
Outcome variable: Depressive symptoms T2				
Intercept	.07	--	--	--
Gender	-.05	.07	.45	[-.19, .08]
Depressive Symptoms T1	.55	.06	< .001	[.44, .67]
Time on SM T1	.01	.01	.18	[-.007, .04]
ASMC T1	.05	.03	.07	[-.004, .11]
Indirect effect:	.006	.004	--	[-.0004, .01]
Step 2: Moderated Mediation Model (H3a)				
A-path				
Outcome variable: ASMC T1				
Intercept	2.60	--	--	--
Gender	-.60	.30	.04	[-1.19, -.02]
Depressive Symptoms T1	.61	.16	< .001	[.30, .92]
Time on SM T1	.14	.04	< .001	[.07, .21]
Time on SM T1 x Gender	-.06	.06	.31	[-.19, .06]
B-path				
Outcome variable: Depressive symptoms T2				
Intercept	.01	--	--	--
Gender	.08	.18	.67	[-.28, .43]
Depressive Symptoms T1	.55	.06	< .001	[.43, .66]
Time on SM T1	.01	.01	.61	[-.02, .03]
ASMC T1	.08	.04	.03	[.01, .15]
Time on SM T1 x Gender	.02	.02	.44	[-.03, .06]
ASMC T1 x Gender	-.06	.06	.24	[-.17, .04]
Indirect effect (Index of Moderated Mediation):	-.01	.01	--	[-.03, .004]

Note. "ASMC" is appearance-related social media consciousness. "SM" is social media. Gender coded as 0 = girls, 1 = boys.

Table 4. Moderation model statistics (H2b) and three-way interaction model statistics (H3b)

Step 1 (H2b)	b	SE	*p*
Intercept	.03	--	--
Gender	-.05	.07	.43
Depressive Symptoms T1	.55	.06	< .001
Time on SM T1	.02	.03	.36
ASMC T1	.06	.04	.13
Time on SM x ASMC T1	-.003	.01	.67
Step 2 (H3b)			
Intercept	-.22	--	--
Gender	.45	.27	.10
Depressive Symptoms T1	.54	.06	< .001
Time on SM T1	.06	.04	.14
ASMC T1	.15	.06	.02
Time on SM x ASMC T1	-.01	.01	.17
ASMC T1 x Gender	-.19	.09	.03
Time on SM x Gender	-.08	.06	.18
Time on SM x ASMC T1 x Gender	.03	.02	.10

Note. ASMC is appearance-related social media consciousness. Time on SM is time on social media. Gender coded as 0 = girls, 1 = boys.
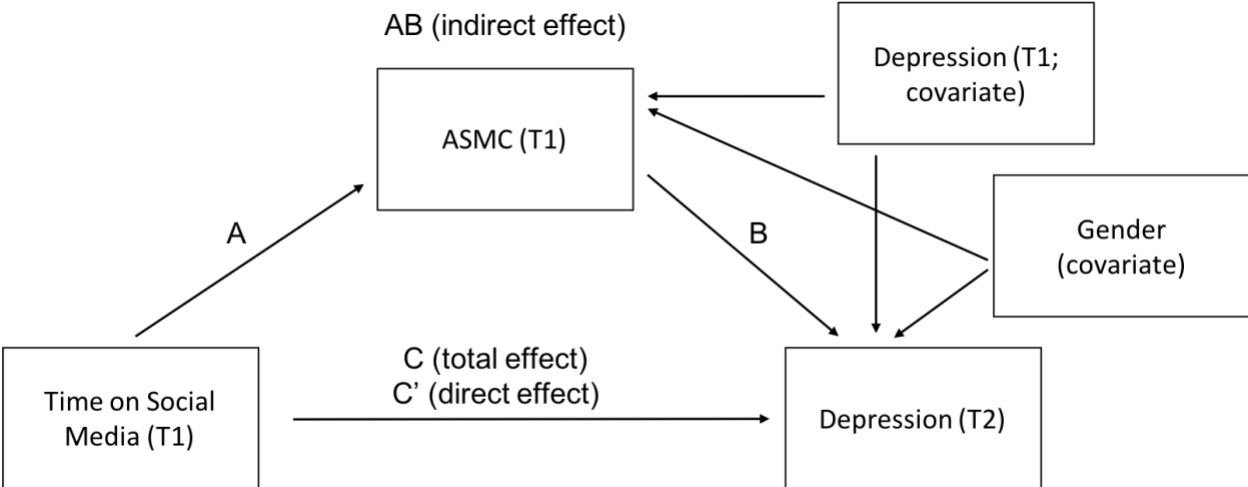
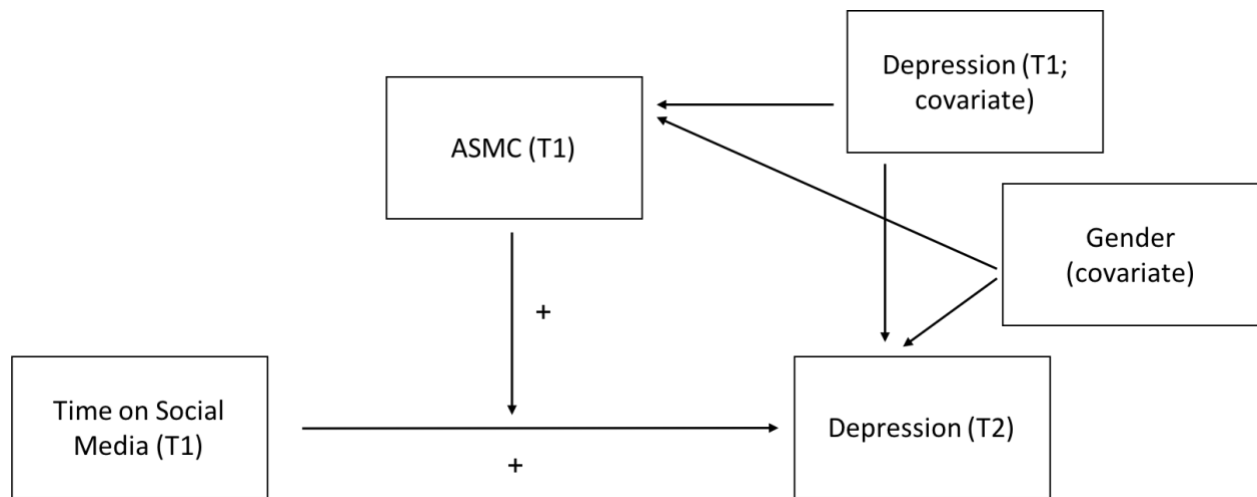**Figure 1. Conceptual mediation model (H2a).**

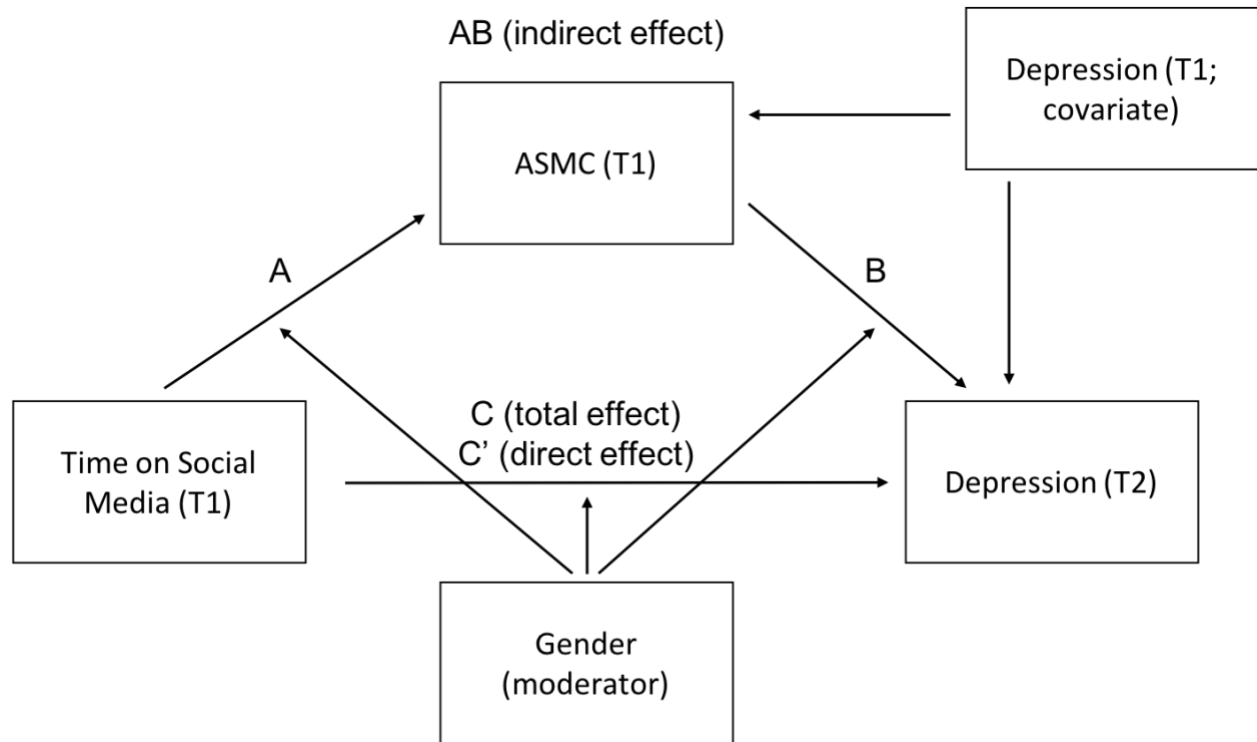**Figure 2. Conceptual moderation model (H2b).**

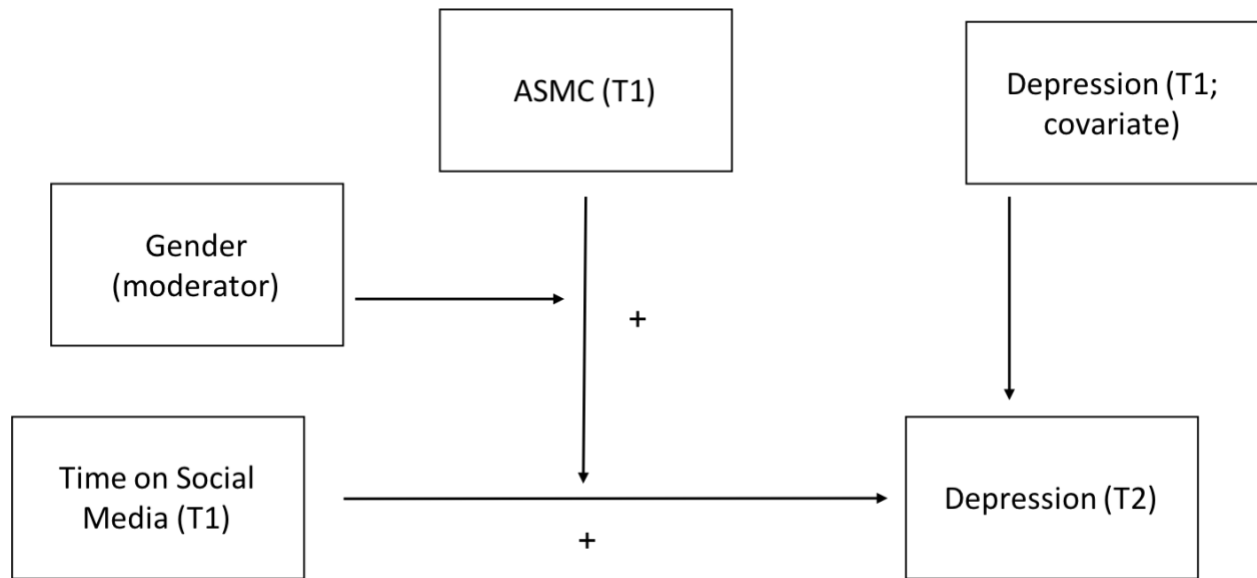**Figure 3. Conceptual moderated mediation model (H3a if H2a supported).**

Figure 4. Conceptual moderated moderation (i.e., three-way interaction) model (H3b if H2b supported).
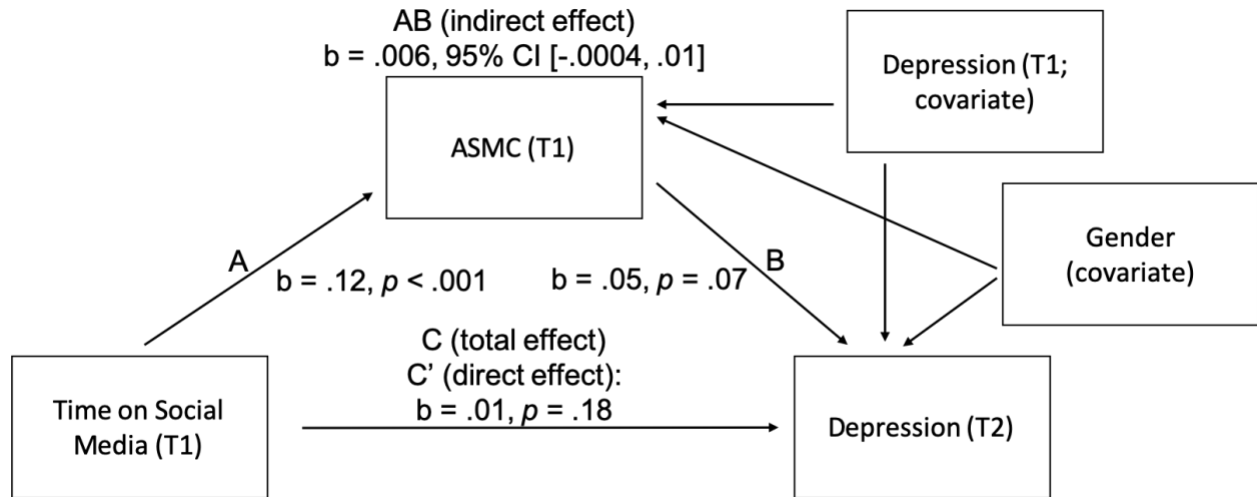
Figure 5. Mediation model (H2a) including coefficients for key pathways.
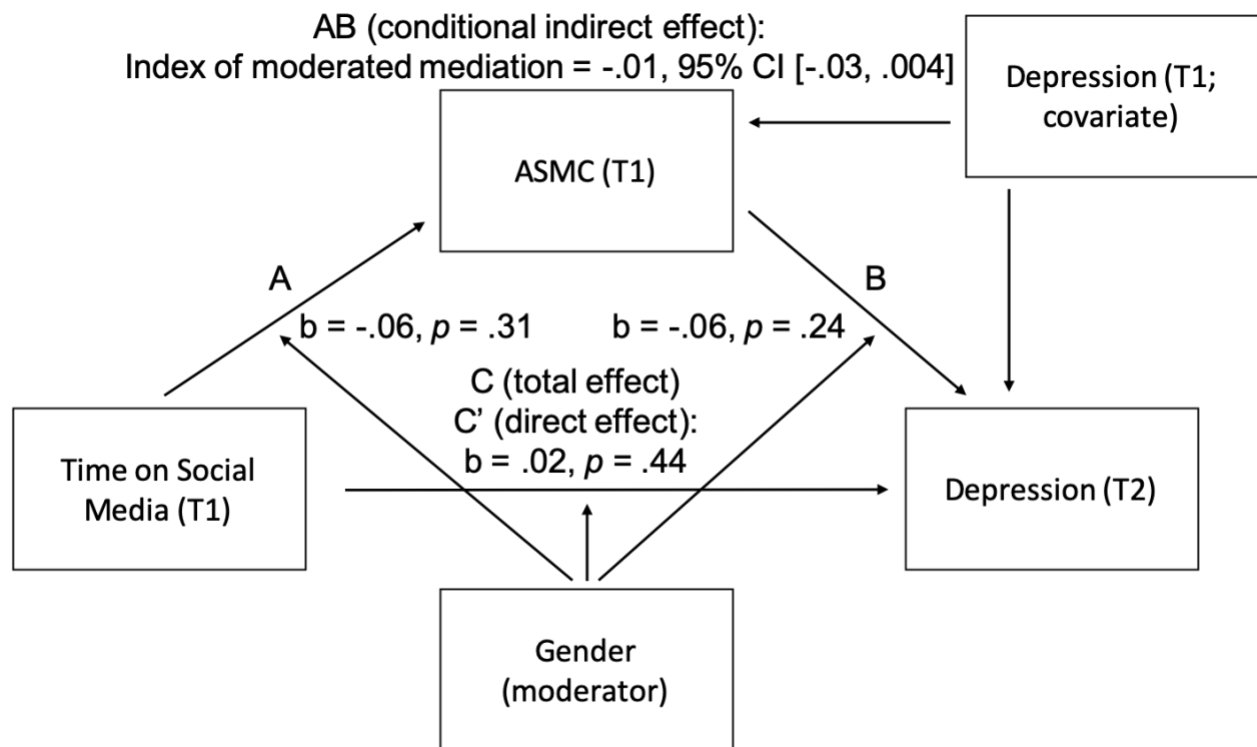
Figure 6. Moderated mediation model (H3a) including coefficients with gender interactions for key pathways.

Appendix C ASMCS: Appearance-Related Social Media Consciousness Scale

(Choukas-Bradley, Nesi, Widman, & Galla, 2020)

The next questions ask about your experience with social media. When we say "social media," for this scale, we are referring to photo-based social media sites and apps like Facebook, Snapchat, and Instagram. We are NOT talking about dating websites or apps such as Tinder.

Please read each statement and decide how frequently this happens for you.
1=Never, 2=Almost Never, 3=Rarely, 4=Sometimes, 5=Often, 6=Almost Always, 7=Always

1. When people take pictures of me, I think about how I will look if the pictures are posted on social media.
2. I think about how specific parts of my body will look when people see my pictures on social media.
3. Even when I'm alone, I imagine how my body would look in a social media picture.
4. During the day, I spend time thinking about how attractive I might look when people see pictures of me on social media.
5. I try to guess how people on social media will react to my physical appearance in my pictures.
6. My attractiveness in pictures is more important than anything else I do on social media.
7. When I go to social events, I care more about looking attractive in pictures people might post on social media than I care about having a fun time.
8. If an unattractive picture of me is posted on social media, I feel bad about myself.
9. I look at pictures of myself on social media again and again.
10. I zoom into social media pictures to see what specific parts of my body look like.
11. If someone takes a picture of me that might be posted on social media, I ask to look at it first to make sure I look good.
12. Before I post pictures on social media, I crop them or apply filters to make myself look better.
13. If someone takes a picture of me that might be posted on social media, I pose in a particular way so that I'll look as attractive as possible.

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