Magic Mirror, Magic Mirror, Am I Attractive: the Effect of Virtual Makeover Uses on Chinese College Females' Self-evaluation

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In the recent years, photographic filters (e.g. Snapchat lenses) are gaining tremendous popularity among young people. Some filters adjust one's look to make it better align with the narrowly defined societal beauty of unblemished skin and defined facial features. College-age females are especially drawn to these tools as they are under great appearance pressure and are heavy users of photo sharing-based social media platforms. Yet, the psychosocial impacts of virtual makeover use on these young females remain unclear. Extending social comparison theory, this study considered a digitally enhanced image of self as a novel upward appearance comparison target and investigated the impact of exposure to such images on Chinese college female's self-evaluation and mood with an experimental design. A sample of 205 undergraduate female students attending a college in China participated in this study. Findings showed positive impact of virtual makeover use on Chinese college females' explicit state physical appearance self-esteem and mood but not on implicit self-esteem. For those who were exposed to a selfie with virtual makeover applied, the more enhancement they perceived, the more positive their explicit self-evaluation and mood. The extent to which these college females view physical appearance was malleable was not found to be moderating the impact of virtual makeover use on self-evaluation with this sample. Implications for future research and practical work are discussed.

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Introduction

Physical appearance self-concept is a very important aspect of psychological and interpersonal development, especially for females (Levine & Smolak, 2002). This generation of young females encounters a barrage of social messages linking physical attractiveness with romance, popularity, happiness, and success (Susan Harter, 2015; Kiang & Harter, 2006), which feed an obsession with appearance (Tiggemann, 2005). Among various domains of self-concept, physical appearance is the most powerful contributor to global self-esteem (Harter, 2015). Dissatisfaction with one's own physical appearance not only directly links to desire for cosmetic surgery (Markey & Markey, 2009), but also causes social anxiety (Kostanski & Gullone, 2019) and depression (Kostanski & Gullone, 2019; Tolman et al., 2006) via lowered global self-esteem. It is therefore crucial to understand the sociocultural and psychological factors that might influence young women's appearance-related self-evaluation. Previous studies have examined the role of mass media and social media in conveying unrealistic standards of attractiveness and in encouraging adolescents' dissatisfaction with their body image (see review by Fardouly & Vartanian, 2016; Grabe, Ward, & Hyde, 2008). However, scholars to date have not attended to an increasingly common phenomenon among young females: frequent exposures to digitally enhanced self-images. Exposures to an altered image of self, which is a by-product of selfie manipulation activity, might be a new factor influencing individuals' appearance-related self-evaluation.

Selfie-manipulation, as a way to fulfill individuals' desire for ideal online presentation (Bij de Vaate et al., 2018; Chae, 2017), has become the norm among young females. A new

technology, the beauty filter, was created to help young females look “up-to-standard” in the digital world effortlessly. Applying augmented reality, artificial intelligence and computer vision, a beauty filter can detect facial features captured by the camera and apply real-time changes to them (e.g., smoothing out the skin, enlarging the eyes, etc.). Unlike traditional photo-editing tools, which require the users to engage in deliberate editing to enhance their photos, beatifying filters automatically generate enhancing effects based on preset algorithms that were built favoring narrowly defined society beauty standards of unblemished skin and defined facial features.

The beauty filter industry has been blooming over the past few years. In 2013, the Meitu company launched the first beauty camera mobile application in China, leading a new trend of beauty and makeup camera apps. These applications gained great success from the market. B612, a selfie app featuring beauty filters and stickers developed by the Line corporation in Japan reached over 10 million downloads within 14 months after its release in 2014. In 2015, Snapchat released the “Lenses” feature, allowing users to add real-time effects into their snaps by using the face detection technology. In the following years (2017-2019), standalone beauty filter apps including Meitu Xiuxiu, Faceu, Ulike and Wuta dominated the “photo and video” genre of mobile apps in both iOS and Android app stores in Asian countries. Following the trend, an increasing number of social media applications around the world (e.g., Tiktok, Instagram, SNOW) have adopted beauty filters as a feature. Chinese adolescent girls and young women, for whom dissatisfaction with facial features is an even stronger contributor to appearance concerns than weight concern (Chen et al., 2006), are among the most avid users of beauty filters. In China, beauty filters have even become a selling point of a number of smartphones (e.g., VivoX2, Huawei P20). As a result of the widespread use of beauty filters, Chinese young

females are exposed to digitally enhanced self-images on a daily basis. However, it remains unknown whether seeing a digitally enhanced self-image that is different from the self-reflection in a mirror changes how Chinese young females evaluate their physical appearance.

Self-appraisal is such a fundamental, ubiquitous and robust human proclivity (Sedikides et al., 2015) that it is natural for young women to seek out information on how good they look. According to sociocultural models of body image development (Berg, Thompson, Obremski-Brandon, & Coovert, 2002; Keery, van den Berg, & Thompson, 2004), one of the major pathways through which people gather information about their own level of physical appearance is social comparison. Research has shown that women regularly evaluate their appearance by comparing themselves to others (Leahey et al., 2007; T. A. Myers & Crowther, 2009). These comparisons can take place both offline and online (Fardouly et al., 2017; Leahey & Crowther, 2008), both consciously and spontaneously (Henderson-King et al., 2001). Though the direction of comparison can be either upward or downward, females are particularly likely to engage in upward comparisons with better-looking peers, images of models, celebrities, even strangers. The effects of upward appearance comparisons are frequently conceptualized in terms of "contrast effects"—a tendency to evaluate one's own appearance more negatively after seeing more attractive individuals, as derived from the tenets of social comparison theory (Festinger, 1954). Exposure to highly attractive female images in the media outlets is thought to remind people of the unattainable societal standard of beauty, which should result in lowered assessment of oneself. By contrast, some contemporary models of social comparison propose "assimilation effects" in upward comparison, a tendency to perceive oneself as similar to the comparison target and be positively influenced by the comparison (Collins, 1996; Lockwood & Kunda, 1997; Mussweiler, 2003).

Extending this work, the current study considers digitally enhanced selfies generated by beauty filters as a new source of information for young females' appearance-related self-appraisal. With the technology of beauty filters, people are not just seeing an airbrushed image of a celebrity and measuring themselves up to that person; they are also measuring their real self against an airbrushed version of self in the digital world.

The concept of comparing to a "better-looking self" may seem novel, but people frequently engage in self-comparison thinking in everyday life: "I look much better with this new haircut"; "Having a tan makes me look more attractive"; "I get a healthier look this year since I've been working out and eating healthy." This process of comparing selves at various points in time is referred as temporal comparison (Albert, 1977), which is found to be relevant to self-appraisal (Suls et al., 1991). New technologies such as the selfie-manipulation tools and character customization in video games allow people to create and present digital selves that are different from their offline self, making self-comparison beyond the temporal dimension possible – one can now compare to one's offline self to an online self.

It is proposed that such comparison may function through similar mechanisms as the social comparison. When young females see a digitally enhanced selfie presented on their smart phone, they would engage in a comparison process that resembles the upward appearance comparison. According to the theory of objective awareness (Ickes et al., 1973) when people focus attention on themselves, they have a natural tendency to compare his/her present condition with his/her aspiration. In terms of physical appearance, one's aspiration is greatly influenced by the society and media. The airbrushed image that is automatically generated by beauty filters that are designed to help individuals to meet the societal standard of beauty. It canfunction as an actualization of one's ideal look (Chua & Chang, 2016) against which one can evaluate one's

actual look. Though the comparison target is a “better-looking” self instead of a better-looking other under this scenario, the comparison still has some “social” components. After all, the major function of beauty filters is to help create photos to be posted on social media platforms and viewed by a broad audience of peers (Choukas-Bradley et al., 2018). As a result, when seeing an airbrushed image of self, a young female may find herself processing it as a potential social media photo and assess it through a third person’s perspective in terms of its attractiveness (Choukas-Bradley et al., 2018). Similar to comparison to a better-looking other, this assessment can lead one to think about whether or not one’s unfiltered look is as attractive as the filtered look or has the potential to be as attractive.

Then the question is: will the comparison to an airbrushed virtual self be perceived in ways that flatter or deflate the real self? How do we formulate hypotheses about the impact of such comparison on self-evaluation? The approach taenk by researchers to investigate temporal comparison provides some clues. When Albert (1977) proposed the temporal comparison theory, he formulated his major propositions by translating principles of social comparison theory, an approach he called “conceptual translation.” He argued that past selves can be likened to “others” against whom the current self is measured.Empirical studies on temporal comparisons (Wilson and Shanshan, 2020) have validated the usefulness of Albert’s (1977) approach. By testing propositions derived from social comparison theory, these studies revealed general mechanisms shared by temporal comparison processes and social comparison processes. For the current study, I proposed that comparison to a filtered image of self can also be viewed as parallel counterparts to the complex and actively constructed upward social comparison process, given the resemblances between these two processes as described above.

Expanding the current literature investigating sociocultural influences on young females' body image from a social comparison perspective, this dissertation explores the impact of beauty filter use on Chinese college females' self-evaluation. Would exposure to airbrushed selfies influence Chinese college females' self-image? Which individuals' self-images are more likely to be influenced when looking into the magical mirror with beautifying effect? In addressing these questions, this dissertation aims to make theoretical contributions on two fronts: (1) contributing to the burgeoning literature on adolescents' use of new selfie-editing technologies and its impact on their psychosocial development and (2) expanding the application of social comparison theory by examining a possible new target for upward appearance comparison.

Literature Review

Social Comparison Theory: a brief overview

When Festinger (1954) introduced social comparison theory, he made three proposals. First, people have the motivation to know whether or not their opinions are correct and what they are capable and not capable of doing. Second, when there is no objective standard in the environment for direct evaluation, people evaluate their opinions and abilities by comparing to others. Third, there is a tendency to compare to others who are similar to oneself on relevant attributes, as such comparison permits a relatively accurate attribution of the cause of difference. In this original work, Festinger emphasized the role of social comparison in generating pressure toward uniformity with others in the group, as he was interested in psychosocial processes contributing to group consensus. Later applications of the theory moved the focus away from group processes, concentrating instead on the evaluative consequences of social comparison on individuals.

Researchers differentiate two types of social comparison based on the relative standing or status of the self and the comparison target on the dimension of comparison. Upward comparisons (Wheeler, 1966) occur when individuals compare themselves to someone whom they believe to be better off than themselves, and downward comparisons (Wills, 1981) occur when individuals compare themselves to someone whom they believe to be worse off than themselves. With the exception of two studies (Thornton & Arrowood, 1966; Wheeler, 1966), most of the early work on social comparison held two suppositions: First, the nature of social comparison is contrasting one's abilities or attributes with those of others; second, the evaluative implications of social comparison are intrinsic to the direction of comparison (Brickman & Bulman, 1977). Upward comparisons are likely to produce negative consequences, such as decreased self-esteem, since they made people realize how much one falls short of superior others. Downward comparisons are likely to produce positive consequences, such as increased self-esteem, by highlighting one's advantages and outperformance over others (Wills, 1981).

Thornton & Arrowood (1966) and Wheeler (1966), on the other hand, suggested that individuals may make social comparisons that didn't necessarily involve contrast. Wheeler (1966) speculated that when individuals assumed similarity between themselves and the superior other, they might engage in upward comparison to confirm that they were "almost as good as the very good ones" (p.30). Thornton and Arrowood (1996) posited that there were two different motivations for making social comparison: self-evaluation and self-enhancement. By comparing with someone who exemplifies a positive trait/ability, individuals could not only address self-evaluation by contrasting oneself with the desirable standard, but also self-enhancement by identifying with the superior other. Wood (1989) proposed a third motive for upward comparison: self-improvement. Individuals might seek upward comparison to get inspiration and

information about how to improve rather than to evaluate one's relative status to the superior other. Buunk, Collins, Taylor, & VanYperen (1990) provided empirical evidence that comparison can produce positive or negative feelings independent of direction (upward or downward comparison), but dispositional and situational variables could modify effects. For example, cancer patients who were low in self-esteem and who perceived little control over symptoms were more likely to feel worse after upward comparison, whereas patients high in self-esteem reported more benefits from upward comparison as they were encouraged by another's successful coping and recovery.

Theories of Upward Social Comparison

Upward comparisons seem particularly salient in studies of how youths respond to edited selfies because they are, ostensibly, improved self-portraits. Thus, theories regarding the effects of upward comparisons are especially germane to the current study. Several scholars have proffered theories of upward social comparisons, each articulating claims about the effects of upward social comparison and the proposed mechanisms and factors accounting for such effects.

Self-relevance of the superstar and perceived attainability. Lockwood & Kunda (1997) proposed that making comparisons to a superstar can lead to self-enhancement and inspiration under some circumstances and to self-deflation under others. There are also circumstances when individuals consider the superstar as irrelevant to the self and thus are not influenced by exposure to him/her at all. For instance, one may watch Olympic medalists' performance without experiencing any change in self-evaluation.

There are two types of situations in which an outstanding other might be considered as relevant to oneself. First, in line with Festinger's (1954)'s claim that individuals tend to compare to similar others, individuals may consider outstanding others who are similar to them in various

dimensions (e.g. age, gender, race, personality) as relevant. As one's overall perceived similarity to an outstanding other increases, the other is perceived as more relevant and is therefore more likely to affect one's self view. Second, the self-relevance of the superstar's domain of excellence also increases the likelihood that one will compare oneself to the super star. The self-view of a physicist is more likely to be influenced by exposure to a Physics Nobel Prize winner than comparisons to an Olympic medalist. This is not to say that domain self-relevance is essential for social comparison. If the comparer perceives enough other similarities with the superstar, the superstar may still affect self-view even if the comparer excels in a nonrelevant domain. For example, when the Olympic champion is the physicist's best friend or sibling, who shares a lot of common characteristics and circumstances, comparison to the Olympic champion might still influence the physicist's self-view by prompting the physicist to consider whether or not he or she has achieved any top honor in the field of physics.

When the superstar is considered to be relevant to oneself, comparison to him or her is likely to influence one's self-evaluation. Lockwood and Kunda (1977) suggested that whether the consequence is positive or negative depends on the perceived attainability of the superstar's excellence. If the success of the superstar seems attainable, one might be encouraged and inspired by the comparison as it shows the level of accomplishment one can hope to achieve. If the success of the superstar seems unattainable, comparison to the superstar highlights one's own failures and shortcomings. Realizing the success of the superstar is out of one's reach may diminish one's self-evaluation.

Upward assimilation theory. Collins (1996, 2000) proposed that when people compare themselves to better-off others, they might look for and expect to find congruence with them. As a result, self-evaluation may increase in response to upward comparisons, allowing comparers to

conclude that they are “among the better ones,” which is referred to as the assimilation effect. This idea was greatly influenced by Fiske & Taylor's (1991) theory of social cognition that information processing is a top-down process, driven by expectations, especially when the implication of the information is ambiguous. There are situations when the implication of social comparison is quite clear—when the difference between self and target is large, relative to the comparer’s subjective distribution of the comparison dimension. In these situations, the revealed discrepancy is clear and should automatically evoke contrast. But in most comparisons, the difference between self and target is only moderate and can be interpreted in both ways, just as the proverbial glass being half full or half empty. The evaluative implications of the social comparison then depend on two factors: the direction of the comparison and the comparer’s expectation that he or she will be similar to the target on the characteristic being evaluated. Because most people are motivated to view themselves in a positive light, they are especially likely to expect similarity to the “better others” in upward social comparison. Such expectation will enhance the likelihood of assimilation to the “better others”: “He is good, and because I am pretty much the same, I must be good, too.”

Collins further identified several factors affecting the expectation of similarity. First, *the actual similarity between the self and the target* in the dimension of evaluation is likely to influence the expectation of similarity. Most individuals would never expect to swim as well as Michael Phelps as they know his swimming record is beyond most people’s range of abilities. They are much more likely to expect doing well in a regional swimming competition, as someone with a similar record got the championship in this competition last year. A second factor that may promote expected similarity on the comparison dimension is *the similarity on related attributes*. Individuals usually expect those who are similar to them in some ways to be

similar to them in others (Goethals & Darley, 1977). In addition, *self-esteem threat* should influence expected similarity. Negative feedback or experience related to the dimension of comparison is likely to lower one's expected similarity with a superior other. Similarly, individuals of *chronic low self-esteem* are less likely to believe they are similar to "the better ones." Collins emphasized that all of these factors could influence the probability of the occurrence of an assimilation effect by enhancing the expectation of similarity, but none of them necessitates this response.

The Selective Accessibility Model. Similarly to Collins' upward assimilation theory, Mussweiler's (2003) selective accessibility model is influenced by social cognition theories, approaching the comparison processes from an informational perspective. The evaluative consequences of comparisons on the self depend on the implications of the judgment-relevant knowledge that is activated and rendered accessible during the process of relating the characteristics of the self to the critical features of the standard.

The selective accessibility model (Mussweiler, 2003; Mussweiler et al., 2004; Mussweiler & Strack, 2000) conceptualizes the informational comparison consequences as a product of a hypothesis-testing process by which judges actively seek and generate self-related information that is consistent with the hypothesis the judge has about the comparison. In principle, there are two alternative hypothesis-testing processes: similarity testing and the dissimilarity testing. In similarity testing, individuals test the hypothesis that their standing on the judgmental dimension is similar to that of the standard; in dissimilarity testing, individuals test the hypothesis that their standing on the judgmental dimension is different from that of the standard. The informational and evaluative consequences of these alternative hypothesis-testing processes are antithetical. Similarity testing selectively renders accessible information indicating

one's similarity to the comparison standard and therefore places oneself towards the standard (i.e., an assimilation effect). Dissimilarity testing selectively renders accessible knowledge indicating one's stance is different from that of the standard and as a result places the self away from the standard (i.e., a contrast effect). In upward comparison, assimilation to the comparison standard increases one's self-evaluation, whereas the opposite is true for contrast.

The selective accessibility model (Mussweiler, 2003; Mussweiler et al., 2004; Mussweiler & Strack, 2000) assumes that whether the judge engages in similarity testing or dissimilarity testing depends on a quick holistic assessment of the similarity between the self and the comparison standard. This initial assessment can be influenced by salient features of the self and the comparison standard, such as category memberships. For example, when a nonathletic individual compares his lung function to a swimmer's, a brief consideration of how regular exercise benefits the respiratory system is adequate to determine that their similarity is low; subsequently, this nonathletic individual engages in dissimilarity testing. Mussweiler (2003) suggested that other factors found to be associated with the occurrence of assimilation versus contrast, such as the attainability of the standard's standing on the comparison dimension examined by Lockwood & Kunda (1997), might have an impact by inducing the individual to test either similarity or dissimilarity. In addition to attainability of the comparison standard, these factors include (1) the extremity of the comparison standard –people are more likely to form an impression of dissimilarity when compared to an extreme standard and more likely to see the similarity when compared to a moderate standard; (2) the mutability of the self – similarity is easier to assume when the self is mutable and the boundary between the self and the comparison is ambiguous; (3) the psychological closeness between the self and the standard – when an individual is psychologically close to the comparison standard, he or she is more likely to tend to the

similarities and engage in similarity testing; and (4) motivations for making the comparison – when the most prominent motivational concern is to restore or enhance the self-image, people might concentrate more on the similarity with the upward comparison.

In terms of the relative prevalence of similarity testing and dissimilarity testing, Mussweiler (2003) suggested that similarity testing constitutes the default. Individuals are more likely to focus on similarities than dissimilarities in the initial holistic assessment because to make the assessment, individuals need to establish an alignable structure between the self and the comparison standard first. Such a system naturally guides individuals' attention to features of self that are alignable to the comparison standard. However, this does not mean the evaluative consequences of comparison is primarily assimilation, as the selective accessibility mechanisms is not the only mechanism that functions during a comparison (Mussweiler, 2003). In addition to the selectively accessible judgement-relevant knowledge of self, which is usually consistent with the comparison standard, Mussweiler (2003) suggested that a comparison also renders judgment-relevant information about the context and comparison standard accessible. In particular, it suggests that the comparison standard can serve as a reference point against which the implications of accessible self-knowledge can be evaluated. For example, in comparing one's academic competence with a friend with high GPA, not only will one consider ways in which one is similar to the friend (e.g. we have classes together, worked on the same assignments), one will also consider how attainable the comparison standard's performance is (e.g., the friend's GPA is much higher than I have ever attained, and hardly anyone scores that high).

Taken together, comparing oneself to a certain standard may have two distinct informational consequences. It increases the accessibility of standard-consistent knowledge about the self. It also provides a reference point against which individuals can evaluate the

knowledge of self. While the selective accessibility mechanism is likely to produce an assimilation effect on self-evaluative judgment in most situations, using the comparison standard as a reference point for self-evaluation is likely to produce a contrast effect. The assimilation and contrast effects may therefore be produced by the very same comparison. Which effect is manifested depends on how relevant the two respective types of information (i.e., self-knowledge and reference point) are for the given judgment.

Summary of the theories. All three theories suggest that the evaluative consequences of upward comparison on the self are not necessarily negative. The effects of comparison depend on whether the comparison produces a self-evaluation that is displaced toward the comparison target (i.e., an assimilative outcomes) or a self-evaluation that is displaced away from the comparison target (i.e., a contrastive outcome). When the self is perceived as similar to the "better one" on the dimension of comparison or when the "better one" is perceived as a possible future self, assimilation occurs; and when "self" is perceived as very different from the "better one" on the characteristics being evaluated or when the better one merely serves as a reference point, contrast occurs. Whereas assimilation leads to positive evaluation of self, contrast leads to negative evaluation of self.

Unlike Musseweiler, who suggested that assimilation and contrast are not mutually exclusive, Lockwood and Kunda (1997) and Collins (1996, 2000) depicted these two outcomes in a more either/or way. The occurrence of an assimilation effect versus a contrast effect is facilitated by individual and contextual factors. First, for a comparison to cause any effect, the comparison standard needs to be relevant to the individual who is making the comparison. Second, the strength of the assimilation effect is influenced by how the individual perceives the comparison standard and the self (e.g. perceived similarity with the comparison standard,

attainability of the comparison standard, self-esteem) and what the individual expects from the comparison (e.g. motivation for comparison).

Applying these theoretical claims to comparison to a digitally enhanced image of self, such an upward comparison is likely to influence one's self-evaluation, as a self-image is likely to be considered as relevant. The exact direction of the effects will depend on how individuals perceive the actual look of self and the enhanced look of self. Assimilation is likely to occur and generate positive effects on self-evaluation when individuals perceive their actual look not as quite worse off the enhanced look and the enhanced look as attainable. Contrast is likely to occur and generate negative effects on self-evaluation when individuals perceive a large discrepancy between the attractiveness level of one's actual look and one's enhanced look or when the enhanced look is merely viewed as a "desirable but unattainable" standard of look. However, to date, studies applying social comparison theory to appearance comparison have been focusing on comparison to others.

Applying Social Comparison Theory to Appearance Comparison

Studies (see reviews by Myers & Crowther, 2009; Want, 2009) applying social comparison theory to examine appearance-related self-evaluation suggest that, lacking an objective standard for determining their own level of physical attractiveness, people seek to compare to others to make evaluative judgments. The association between appearance-focused social comparisons and appearance-related self-evaluation has been examined in correlational studies, which use self-report measures to assess social comparison, and in experimental studies, which induce social comparison by exposing participants to a comparison figure or figures. Most of the studies in this field focus on the effects of appearance comparison on women and are conducted with college-age samples (Ferguson, 2013).

Correlational Studies. There are fewer correlational studies than experimental studies in this field (see review by Ferguson, 2013) because the major focus of research has been on effects of appearance comparisons, for which controlled laboratory settings maximize the internal validity. However, correlational studies make distinctive contributions in understanding the relationship between appearance social comparisons and self-evaluation in natural settings. These studies have addressed three major issues: the association between social comparison tendencies and trait body dissatisfaction, the individual(s) with whom someone is making such comparisons in natural daily settings, and the effects of naturally happening appearance comparison on individuals.

Applying survey methodologies, researchers (Fardouly et al., 2015; Keery et al., 2004; Stomer & Thompson, 1996; Thompson et al., 1999) have revealed that college females who had a stronger tendency to engage in appearance-focused comparison were more likely to have body dissatisfaction. To investigate the frequency, target, and effects of appearance-focused comparisons taking place in everyday life, recent studies (Fardouly et al., 2017; Leahey et al., 2007; Leahey & Crowther, 2008) applied Ecological Momentary Assessment (EMA), which permits the participants to report occurrences of appearance-focused comparisons and subsequent feelings and thoughts in real time. These studies found that women were more likely to make upward appearance comparison than downward appearance comparisons in their everyday life (Fardouly et al., 2017; Leahey et al., 2007; Leahey & Crowther, 2008; T. A. Myers et al., 2012). Although most research on appearance comparison has focused on comparisons to idealized images of women in magazines (Want, 2009), Fardouly et al.(2017) found that this type of comparison was less common than comparisons to other people whom they see and interact with in person. Moreover, women were more likely to make comparisons to images on

social media than on any other media platforms (i.e., television, magazines, billboards) since the rise of photo-based social media platforms (Fardouly et al., 2017). In general, studies applying EMA found that upward comparisons were associated with subsequent increases in body dissatisfaction and negative affect. These researchers also pointed out that the effect of upward appearance comparison is not universal; they identified several individual and contextual factors that moderate the strength of upward comparison effects on individuals, which will be discussed in the "mechanisms of appearance-focused upward comparison."

Experimental Studies. Most of the studies in this area have used experimental methods to examine how women evaluate their appearance after exposures to thin or attractive media models. In a typical experiment, women are shown a series of fashion magazines/TV commercials/music videos/Facebook profiles that contain either images of women who are highly attractive/of ideal body shape, or images that are considered as neutral (i.e. inanimate object; non-ideal images of women). Following the experimental manipulation, respondents are asked to complete assessments of body image-related constructs. Some studies (e.g. Goldenberg, Arndt, Hart, & Brown, 2015) draw inferences about the effects of the comparison based on the assumption that exposure to idealized images automatically evokes comparison; the differences in the assessment results of participants in experimental versus control conditions represents the comparison effects. Other studies (e.g. Bessenoff, 2006) explicitly ask participants to report whether or not they made comparisons. Five meta-analyses of studies have been published concerning the influence of idealized portrayals on female viewers' satisfaction with their own appearance (Ferguson, 2013; Grabe et al., 2008; Groesz et al., 2002; Holmstrom, 2004; Want, 2009), with the most recent (Ferguson, 2013) concluding that the mean effect of exposure to portrayals of thin-ideals on college females' body dissatisfaction is .17, higher than the effects

suggested by correlational studies, but still minimal and subject to moderation by individual and contextual factors.

In recent years, some researchers (Bocage-barthélémy et al., 2018; Gurari et al., 2006; Johansson et al., 2005) have questioned the self-report measures used in these experiments to assess outcome variables, as these measures are sensitive to social desirability and demand characteristics, and can only capture participants' conscious thoughts, feelings, and desires (Nisbett & Wilsom, 1977). These researchers argued that it is possible that participants were able to guess the hypothesis of the study and confirm the expectations by controlling their responses. To verify whether the effects were merely driven by self-presentational concerns, studies were conducted using indirect measures of self-evaluation instead of self-report. For example, in an experiment conducted by Bocage-barthélémy, Selimbegović, & Chatard (2018), young females were exposed either to fourteen photographs of the thin ideal or to the same images airbrushed to make the models look slightly larger. After the exposure, their implicit self-evaluation was tested using the lexical decision task, in which they were asked to identify self-liking verbs. The results showed that women exposed to thin-ideal models took longer to correctly identify self-liking verbs compared to women who were exposed to slightly larger models. Similarly, Chatard & Selimbegović, (2011) found that exposure to the thin ideal increased the accessibility of concepts semantically related to failure, such as suicide, in a lexical decision task. These results suggested that social comparison with ideal images of female appearance lowered implicit self-evaluation among young women.

Mechanisms of Appearance-focused Upward Comparison: Moderators

As mentioned above, researchers have suggested that the effect of exposure to images of attractive/thin females on one's evaluation of self is not universal. Certain factors make some

women more vulnerable than others to the effects of such exposures. Studies conducted in different contexts or following different procedures also reported varied effect sizes. In other words, the strength of the association was moderated by individual and contextual factors.

Individual differences: Pre-existing appearance concerns. Body dissatisfaction and other pre-existing appearance concerns are the most widely examined moderators in this literature (see review by Ferguson, 2013; Groesz et al., 2002; Want, 2009). They are investigated by studies applying different approaches. For example, in an experiment, Heinberg & Thompson (1995) exposed women with either high or low levels of body dissatisfaction and either high or low levels of thin-ideal internalization to appearance- and non-appearance related advertisements. Results showed that only those individuals with high levels of body dissatisfaction and high levels of internalization of the thin-ideal experienced heightened distress and dissatisfaction with their appearance, following exposure to appearance-related material. Similar results were found in an experiment applying implicit measures (Johansson et al., 2005). In this study, researchers hypothesized that negative information is more accessible in body-dissatisfied than in body-satisfied women, after viewing thin-ideal media images. They used an emotional Stroop task to assess the accessibility of failure-related words (such as “defeat” or “worthless”) among participants, assuming that high accessibility of such words would produce greater Stroop interference. Results showed that after thin-ideal exposure, dissatisfied women displayed higher Stroop interference for failure-related words than body-satisfied women. However, in a study examining the effects of naturally occurring appearance-focused social comparison on individuals with high and low body dissatisfaction, Leahey, Crowther, & Mickelson (2007) found that even though body dissatisfied women engage in more upward comparisons than body-satisfied women in their daily life (and were negatively affected by such

comparisons), the negative effect was not stronger for them than for women with higher body esteem.

In general, results of meta-analyses suggested that females with pre-existing appearance concerns were more negatively influenced by upward appearance comparison than those without such concerns (Ferguson, 2013; Groesz et al., 2002; Want, 2009). Researchers provide several possible explanations for this moderating effect. First, some body/appearance dissatisfied females may indeed have appearance that differs more greatly from the narrowly defined societal standard of beauty. Exposures to idealized portrait of female images might therefore heighten their awareness of the discrepancy between their own look and the ideal look (Posavac et al., 1998). Second, and more importantly, females who have existing appearance concerns may have a dysfunctional cognition and process appearance-related information differently from females without such concerns (Leahey et al., 2007; Yamamiya et al., 2005). They may perceive appearance as more central to their value and thus be more influenced by appearance comparison. Moreover, they may pay more attention to the aspects of appearance on which they fall short of the standard and perceive the standard as unattainable. Such information processing schema further reinforce their dysfunctional beliefs of physical appearance.

Individual differences: Motive of appearance comparison. Some researchers (Martin & Gentry, 1997) argued that appearance comparison might lead to different outcomes depending on what motivates the individual to engage in the comparison in the first place. This perspective helps address a commonsense question pointed out by Polivy and Herman (2004): Why do women and girls continue comparing themselves to models in fashion magazines if that makes them feel anxious, depressed, and generally miserable about their bodies? These researchers suggested that in addition to evaluating one's own physical appearance, women and girls may

engage in upward appearance comparisons to get inspiration from these better-off others (Mills et al., 2002) and to fantasize about being one of them (Myers & Biocca, 1992). Indeed, studies found that women and girls buy fashion and beauty magazines not only to compare themselves with the images, but also for entertainment (Thomsen et al., 2002) and inspiration for self-improvement (Smolak & Levine, 1996; Thomsen et al., 2002). In other words, appearance comparison can be motivated not only by self-evaluation but also self-improvement (i.e. comparison with more attractive individuals to seek ways of improving own attractiveness) and self-enhancement (i.e. comparison with more attractive individuals as a biased attempt to maintain positive views of oneself).

In an experiment conducted with teenager girls, Martin & Gentry (1997) investigated whether different motivations for appearance comparison moderate the effects of comparing one's own physical attractiveness with that of advertising models, by manipulating the motivation. Results showed that girls' self-perceptions of physical attractiveness were lowered after self-evaluation but were significantly higher after self-improvement and self-enhancement. In a similar study conducted with college females, Tiggemann, Polivy, & Hargreaves (2009) used a series of ratings to manipulate the instruction set the participants received when they were viewing the magazine advertisements, which produced a control (i.e. focus participants' attention on non-appearance related aspects of images), social comparison (i.e. encourage participants to compare themselves with the images) or fantasy viewing condition (i.e. encourage participants to imagine what it would be like to be the woman in the image). Researchers found that even though participants in both the social comparison condition and fantasy condition experienced lowered appearance self-esteem after viewing the thin ideals, participants in the fantasy

condition experienced increased positive mood while participants in the social comparison condition experienced increased negative mood.

These results suggested that the motivation underlying appearance comparison influences how individuals process the appearance-related information and is crucial to understanding subsequent psychological and emotional responses. Whereas comparing oneself against attractive others for self-evaluation might be deflating, it might generate positive responses when motivated by self-enhancement or self-improvement. However, it does not mean that every social comparison has to have a motivation. Social comparisons are not always effortful and deliberative processes; they can often be spontaneous, fast, and independent of explicit motives (Gilbert et al., 1995). Henderson-King et al. (2001) suggest that females may engage in appearance comparison unconsciously as an inevitable reaction to the stimuli of media portrayals of women.

Individual differences: Perceived attainability of the comparison standard. Few studies have explicitly examined whether individuals' perceived similarity with/attainability of the comparison standard moderates the effects of upward appearance comparison on self-evaluation, but there is some evidence suggesting this possibility. In a laboratory study (Krones et al., 2005), women who were exposed to female peers who typified the thin-ideal reported increased body-dissatisfaction but not negative affect. And in natural settings, Leahey & Crowther (2008) found that regardless of their baseline body dissatisfaction level, college females reported more appearance esteem after upward comparisons with peers than upward comparisons with media images. These might be because people generally view themselves as more similar to their peers and comparing to similar others elicits feelings of self-improvement and beliefs about the attainability of the peer-represented thin-ideal. Brown, Novick, N., Lord, &

Richards (1992) found that when female participants perceived themselves as dissimilar from the physically attractive targets, they reported lowered self-appraisals after viewing their photographs; but when they believed the attractive targets were similar to them in attitudes or even just sharing the same birthday, their perceptions of their own attractiveness were more positive after viewing their photographs. In a study investigating the role of similarity and dissimilarity focus in judgements of other's physical attractiveness, Cypryanska, Bedynska, & Golec De Zavala (2012) found that when participants were primed to focus on objects' similarities, participants rated a model of mediocre attractiveness as more similar to a model of high attractiveness than those who were primed to focus on objects' dissimilarity. Similar mechanism might be responsible for the enhanced appraisal of one's own physical appearance after viewing images of an attractive other who is believed to be similar to oneself.

In terms of perceived attainability, Mills et al. (2002) found that restrained eaters (i.e. dieters), but not unrestrained eaters, rated both their ideal and current body sizes as smaller and disinhibited their food intake following exposure to idealized body images. And such exposure did not make them feel worse about themselves in terms of mood or self-esteem. Instead, there is even a trend towards increased self-esteem after viewing thin body ads. The researchers (Mills et al., 2002) also found that restrained eaters who read an article on evidence for thinness-attainability felt less anxious and better about their bodies than did those who read that thinness is determined genetically. Together, this research suggested that for individuals who view appearance/body-shape as changeable and the comparison standard as attainable, upward appearance comparison might make them envision the possibility of being thinner or more attractive and lead them to reflect on an enhanced, not worsened conception of their appearance.

Contextual differences. Two contextual differences have been investigated as potential moderators in the literature: the extent to which study participants were primed to compare to the portrayals of attractive/thin females and the medium through which participants were exposed to such portrayals.

With regard to the potential differences caused by the instructions participants received before or during the exposure to idealized portrayals, research has provided inconsistent results. On the one hand, some researchers (Cattarin et al., 2000; Mills et al., 2002; Tiggemann & Mcgill, 2004) found that when participants were directly instructed to compare themselves to the appearance of idealized images of other women, they reported greater appearance dissatisfaction than those who were not given explicit instruction and those who were instructed to rate other features of the portrayals (e.g., originality, creativity, etc.). On the other hand, Want (2009) compared the effect sizes of experiments conducted in three different conditions: (1) participants were asked to process or rate some kind of non-appearance related feature of media portrayals as they were viewing them (i.e. distractor condition); (2) participants were not asked to actively process or rate the portrayals as they were viewing them (i.e. neutral condition); (3) participants were asked to actively rate the appearance of the women in the portrayals as they were viewing them (i.e. appearance condition). His meta-analyses show that the effect size was smallest in the appearance condition and largest in the distractor processing condition. The conflicting results might be because Want (2009) did not differentiate the conditions in which participants were asked explicitly to compare one's own appearance to that of the idealized portrayals from the conditions in which participants were merely asked to pay attention to physical appearance in those portrayals. Whereas the former condition makes the differences between oneself and the comparison target salient and may produce a contrast effect, the later condition only makes the

comparison dimension salient and may provoke participants' defensive mechanism, as appearance is central to one's self-image and people are generally motivated to maintain a positive image (Tesser, 1988).

In terms of the medium through which participants were exposed to images of more attractive/thinner females, most of the existing studies focuses on traditional types of media, including fashion magazines, TV commercials, TV programs and music videos. Results of meta-analyses (Ferguson, 2013; Want, 2009) showed that little differences in effect sizes emerged across media type. In recent years, there is an increasing number of studies (Bell & Dittmar, 2011; Fardouly, 2018; Fardouly et al., 2015; Hogue & Mills, 2019; Kleemans et al., 2018; Leahey & Crowther, 2008; Tiggemann & Miller, 2010) investigating the effects of exposures to images of attractive celebrities or peers on social media (e.g., Facebook, Instagram). Results of correlational studies show that viewing photos of attractive females on these platforms was associated with negative self-evaluation of physical appearance and negative affect (e.g. Fardouly et al., 2015), consistent with the effects of upward appearance comparison on traditional media outlets. Applying EMA methodology, Fardouly et al. (2017) found that negative effects of appearance comparison through exposure to media images were even stronger than in-person upward appearance comparisons. Interestingly, in an experimental setting, Fardouly et al.(2015) did not find direct effect of exposure to Facebook on women's satisfaction with their body but increased face, hair, and skin-related appearance concerns. Further studies are needed to investigate whether appearance comparison taking place via different venues impact individuals' self-evaluation differently, but it is possible that a lot of images posted on social media have "face" as the central content (i.e. selfies) and make facial features a more salient dimension of comparison.

Summary. Research has confirmed that social comparison is a crucial sociocultural factor influencing women's self-evaluation, especially their physical appearance self-concept. But appearance comparison seems to differ from comparisons in other dimensions in some ways: First, although it is generally believed that individuals are most likely to compare themselves to similar others, women compare their physical appearance to not only peers in their daily life but also media portrayals of other women. Indeed, they are much more likely to engage in upward appearance comparisons than downward, despite evidence that their self-views are generally threatened by such comparisons. It might be because the depiction of female beauty ideal is so pervasive that women see it as normative and expected. According to Kunda and Lockwood's (1997) theory on self-relevance, attractive models and celebrities might be viewed as relevant appearance comparison standards, despite the obvious differences from oneself, when appearance is a domain of comparison that is highly relevant to oneself. Indeed, Strahan, Wilson, Cressman, & Buote (2006) found that when cultural norms of appearance were not salient, college female participants judged a peer to be a more relevant comparison standard, compared themselves more often with peers, and were more negatively affected by the peer; when cultural norms were salient, participants judged a professional model to be equally relevant, compared themselves more with the model, and felt worse after exposure to the model. Second, although all the recent models of upward social comparison suggest that the evaluative consequences of upward comparison on the self are not necessarily negative, most of the researchers studying appearance upward comparison assumed contrast effects and found negative impact on study participants' evaluation of self. The negative consequences are particularly robust when the discrepancy between oneself and the comparison standard is heightened (e.g., when participants had previous appearance concerns; when participants are directed to compare oneself to an

attractive standard). A possible explanation for this is that, unlike other comparison domains such as academic achievement, everyone's physical appearance is unique (except for identical twins) and is largely decided by genetics. It is harder to assume similarity between oneself and another person in terms of appearance than in terms of learning ability. It is also unrealistic to perceive a better-looking comparison standard as a possible future self, as the space for improvement in physical appearance is quite limited. Therefore, the better-looking others are more likely to serve as the reference point in the comparison from which one' self-evaluation is displaced away. This is not to say that assimilative outcomes never occur in appearance upward comparison. The studies on moderators have revealed that assimilation may take place under certain circumstances, such as (1) when individuals are strongly motivated by self-improvement or engage in fantasy; (2) when the common ground shared by themselves and a better-looking other is more emphasized than differences; (3) when individuals perceive the beauty standard as attainable.

Selfie-manipulation and its impact on self-evaluation

Research on selfie-manipulation has been burgeoning since image-base social media established their dominance, but the total amount of such research is still quite limited and the scope of the research is far from comprehensive. Most of the extant studies (Bij de Vaate et al., 2018; Chae, 2017; Chua & Chang, 2016; Dhir et al., 2016; Lowe-Calverley & Grieve, 2018; Veldhuis et al., 2018) investigated age and gender differences in selfie-manipulation behaviors and psychological mechanisms that lead to such behaviors. Very few studies have examined possible consequences of selfie-manipulation on the individual's view of self. McLean, Paxton, Wertheim, & Masters (2015) found that higher engagement in self photo editing was associated with greater body-related and eating concerns among adolescents. Rhodes et al. (2019) replicated

this study with a college student sample and confirmed the positive correlation between frequency of selfie-editing with body dissatisfaction. Interestingly, in a study conducted with Chinese college female students, Meng, Wang & Lei (2017) found results in a somewhat opposite direction. The results show that the frequency of selfie editing was positively related to subjective well-being and the positive association was fully mediated by positive feedback individuals received online and the enhanced self-concept. Based on self-discrepancy theory and self-verification theory, the researchers suggested that posting edited selfies not only elicits positive feedback from others but also crafts a self-image that is closer to one's ideal self. Both consequences can help verify and reinforce one's positive self-concept, which contributes to subjective well-being. It is important to note that all three studies mentioned here employed a correlational design, undermining any claim of cause and effect. Moreover, studies on selfie-manipulation focus on either the act of editing selfies or the act of posting altered selfies. The specific effects of viewing digitally enhanced selfies have rarely been investigated separately, though it can take place in various scenarios beyond editing and posting.

One of those scenarios is selfie-taking: when taking selfies with beauty filters, the beautifying effects are automatically applied to one's look, so the process is edit-less. In China, most of the selfie-taking apps have a default beauty filter, automatically activated when the app is in use. Even though users can switch filters or adjust the effects of the filters, it is usually difficult for users to entirely de-filter within the app. Therefore, users of these selfie-taking apps are exposed to digitally enhanced self-images throughout the selfie-taking process without any active editing.

A second scenario involves selfie-browsing: regardless of whether or not the selfie is posted on social media, people tend to go back to their selfies and look at them. An increasing

number of selfies saved in individuals' own device or posted on social media are digitally enhanced, due to the widespread use of selfie-editing tools. The selfie-browsing activity, again, is not directly linked with either editing or posting.

Passive use of beauty filters constitutes a third scenario. In some other situations, individuals are exposed to enhanced images in a passive way, such as when seeing oneself in a digitally enhanced groupie taken by someone else or when using a video chat/taking app that has a programmed beauty filter as default. Such occurrences are relatively rare but are becoming a new phenomenon in countries where beauty filter use grows to be the norm. For example, WeChat, the most popular mobile app in China, has released several trial versions with a beauty filter being applied to its video-chat function in recent updates. Without notifying its users of this change, the beautifying effects are forced upon them when they make video calls, as no option is offered to turn off the effects. In these scenarios where viewing enhanced selfies is more of a stand-alone process, individuals' attentional focus is placed on the digitally enhanced self-image, rather than the moment-to-moment enhancing self-image as in the editing process, or the audiences' feedback as in the posting process. In other words, very different psychological mechanisms could be activated in these different components of selfie-manipulation. The effects of viewing digitally enhanced selfie cannot be equaled to the effects of selfie-manipulation in general and needs to be investigated separately.

To date, very few studies have investigated the impact viewing digitally enhanced self-images on self-evaluation. A rare study which provides some clues about people's potential psychological reactions when they encounter such images is Epley and Whichurch's (2008) work on enhancement bias in self-recognition. In one of the experiments, the researchers exposed their participants to a series of pictures, including an original headshot of the participant's face and a

series of images that were more or less attractive versions of the original one, generated by a computerized morphing procedure. Then the participants were asked to identify the original one. They found that, on average, participants were more likely to identify an attractively enhanced version than the original version. It was also found that participants with higher implicit self-esteem were more likely to demonstrate such enhancement bias in self-recognition while there was no correlation between the occurrence of this bias and explicit self-esteem. In another experiment, when participants were asked to identity, as quickly as possible, their own, an attractively morphed, or an unattractively morphed photo of themselves out of a series of lineups composed of strangers' faces, they responded most quickly to the attractive morphed picture, followed by the actual picture and the unattractive morphed picture. Epley and Whichurch (2018) concluded from these results that people tend to show self-enhancement bias in self-recognition, which was produced by a relatively automatic, implicit mechanism. In this study, however, the researchers considered one's implicit assessment of self as a source of the enhancement bias. In other words, the automatic liking of oneself guided people's reactions to enhanced version of self-images. It remains unclear if exposure to enhanced version of self-images could change one's implicit and explicit assessment of self.

Current Study and Hypotheses

The current study addresses this gap in literature by examining how exposure to digitally enhanced selfies generated by automatic beauty filters would influence Chinese college females' self-evaluation. Extending social comparison theory and previous studies on appearance comparison, this study considered digitally enhanced selfies as a novel upward comparison target.

Recall that females are sensitive to appearance-related stimuli and have the tendency to engage in upward appearance comparison. Since a digitally enhanced selfie is an image that better meets the societal standard of beauty than one's unfiltered look, exposure to it may also trigger upward appearance comparison. Such Upward comparison to a better-looking digital self is likely to influence one's self-view. According to Lockwood and Kunda (1997), effects of upward comparison occur when the comparison target is considered as relevant or when the comparison domain is considered as important. Examination of an enhanced selfie meets both criteria. First, the relevance of the comparison target is decided by the extent to which people can draw analogies between the self and the target. When viewing a digitally enhanced self-image, people should experience no difficulty in mapping themselves onto that image – after all, the "magic" effects generated by the beauty filters are merely enhancing the look, not changing them into a whole different person with different personality. Second, as reviewed previously, physical appearance is an especially powerful contributor to self-esteem. And for Chinese students, facial appearance, which is usually the center of selfies, is considered as particularly important (Chen et al., 2006).

However, the effects of upward comparison to digitally enhanced selfie generated by beauty filters is likely to be different from upward comparisons to attractive others. As reviewed earlier, comparison to a more attractive other elicits negative self-evaluative consequences in most of situations, but if the self is perceived as similar to the more attractive one, an assimilation effect could occur. Whereas it is generally easy for people to recognize how their own physical appearance is different from a better-looking other, it is much more challenging for people to explicitly discern the differences between their actual look and the filtered look. For one thing, the enhancement effects generated by a beauty filter are preset by algorithms and

automatically applied to the image being captured. The automatic process makes it almost impossible for people to have as a clear an idea of the nature or degree of the enhancement as they would if a manual editing tool were used. The ease of generating enhanced selfies with new technology has greatly blurred the boundaries between fantasy and reality. For another, presentation of authenticity is a widely valued social norm on social media platforms (Uski & Lampinen, 2016). When people create photos with face filters to share on social media, they typically look for a beauty boost without looking heavily edited. In other words, the actual difference between a filtered look and an unfiltered look can be subtle. Moreover, individuals are likely to attend more to the similarities between themselves and the enhanced image than dissimilarities. According to self-enhancement theory (Alicke et al., 2013; Taylor & Brown, 1988), people have a tendency to focus on positive information about the self, relative to negative information, and think about themselves in positive terms. It is more appealing to believe that the digitally enhanced selfie largely represents a potential future self (i.e., "I can look this good if I attend to my appearance a bit more") than to dwell on the gap between one's unfiltered and filtered looks (i.e., "I can never look this good without the filter"). Lastly, people are unlikely to turn to an airbrushed image of themselves to seek accurate evaluation of their physical appearance, but to seek a positive self-image (self-enhancement) or to gain information and hints on how to improve (self-improvement). These motivations would guide people to focus more on the positive sides of the comparison as well. Putting it all together, it is reasonable to expect that when a digitally beautified selfie serve as the upward appearance comparison targets, they are likely to elicit the assimilation effect rather than the negative effect.

The effects of assimilation will be reflected in temporarily positive changes in mood and self-evaluation (Mussweiler et al., 2004). More specifically, assimilation to a digitally enhanced

self-image is likely to bring about positive moods and increase self-evaluation of physical appearance. Since physical appearance is a domain of self-concept that contributes most strongly to global self-esteem (Harter, 2015), the enhanced feeling about one's look may also render general positive thoughts about the self more accessible, increasing implicit self-evaluation. For the current study, it is hypothesized that Chinese college females will experience higher physical appearance self-esteem, more positive affect, and higher implicit self-esteem after looking at a digitally enhanced selfie ("beauty camera condition") than after looking at a selfie without enhancement ("regular camera condition"). The design of the experiment includes "regular camera condition" as a comparison group to demonstrate that it is specifically the digital enhancement generated by the beauty filters, not exposure to one's image in general, that leads to the hypothesized effect. Because relatively more stable traits are unlikely to be affected by short-term experimental exposure (Want, 2009), state measures of physical appearance self-esteem and affects are used to capture fluctuations in moment-to-moment feelings of self-evaluation and moods.

H1: Chinese college females will experience higher state physical appearance self-esteem, higher state positive affect, and higher implicit self-esteem after looking at a digitally enhanced selfie than after looking at a selfie without enhancement.

The study also aims to examine individual factors that might influence the level of assimilation effect elicited by exposure to a digitally enhanced self-image. In other words, which individuals are more likely to believe they are or could be as attractive as the beautified avatar showing on the screen? Since an assimilation effect is stronger for people who view the comparison standard as more attainable (Lockwood & Kunda, 1997), two factors that might influence individual's perceived attainability of more attractive filtered look were examined in

this study: *fixed vs malleable mindset of physical appearance* and *perceived level of digital enhancement.*

First, college females may hold different beliefs regarding the malleability of physical appearance. Outside the beauty sphere, people's assumptions on whether a particular trait if changeable or not have attracted a lot of scientific attention. Dweck (2000) suggested that people with an entity perspective believe traits are fixed and stable whereas people with an incremental perspective assume traits are malleable and changeable. In terms of physical appearance, there might be people who believe that how pretty one is depends largely by nature and there is not much one can change about it; whereas some others might argue that it is possible to greatly improve one's physical appearance.

College females' beliefs about the malleability of physical appearance could influence the extent to which an enhanced look generated by a beauty filter would be perceived as attainable in real life. In a study on upward comparison to an academic star, Lockwood and Kunda (1997) found that students who viewed academic ability as flexible were more likely to view the star's success as attainable than were students who held a fixed theory of academic ability. Similarly, people who view physical appearance as something that can be improved with effort (e.g. lose weight, wear makeup) are more likely to view the enhanced look's level of physical attractiveness as attainable. The digitally enhanced selfie can serve as a source for inspiration, showing potential ways of enhancing one's look. It is also easier for people with flexible view of physical appearance to engage in a fantasy of being more attractive when looking at a digitally enhanced image of self: "One day in the future I may look just as good as this." In contrast, those who view physical appearance as fixed would assume less ability to improve their look to be as attractive as in the enhanced images. The enhanced image may even

remind them of how they fall short of the beauty ideal and lead to a contrast effect. That is to say, the impact of virtual makeover is moderated by people's mindset of physical appearance, with the assimilation effect being stronger for people who perceive physical appearance as more malleable.

When testing mindset of physical appearance as a moderator for the impact of exposure to digitally enhanced selfie on psychological outcomes in the current study, exposure to an un-filtered image of self captured by a regular front camera can still serve as the comparison group. A regular front camera does not improve one's look in any way. So, it is not supposed to bring out an assimilation effect regardless of whether or not one perceives physical appearance as malleable. Even if people with more malleable mindset have a more optimistic view about their look and hence more positive self-evaluation after looking themselves as captured by the regular camera, the moderating effect would not be as strong.

H2: Mindset of physical appearance will moderate the impact of exposure to digitally enhanced self-image and dependent variables (physical appearance self-esteem, state positive affect, implicit self-esteem), with the impact being stronger for Chinese college females with more malleable mindset of physical appearance.

Second, when seeing a digitally enhanced selfie, college females' perception of the enhancement level may indicate how they evaluate their actual look against the enhanced look. When people who believe the level of editing is only minimal, they are more likely to feel the attractiveness level is within their reach and experience a stronger assimilation effect. On the other hand, for people who perceive a higher level of enhancement, they are seeing a larger gap between their unfiltered look and the filtered look which signals difficulties in attaining the attractiveness in real life without the digital magic. The assimilation effect is therefore weaker.

H3: After looking at an enhanced selfie, Chinese college females who perceive lower levels of digital enhancement will experience higher state physical appearance self-esteem, higher state positive affect, and higher implicit self-esteem.

Besides mindset of physical appearance and perceived level of digital enhancement, several other individual-level factors that might affect the effects of comparison process were measured and included in this study as covariates, including baseline appearance satisfaction (Ferguson, 2013; Groesz et al., 2002), trait self-esteem (Collins, 1996), narcissism (Robins & Beer, 2001), and dispositional affect (Brown & Mankowski, 1993). In addition, this study also included an objective measure of participants' facial attractiveness, considering that the effect of beauty filter may be different for people with level of attractiveness. For those whose look already aligns well with the societal standard of beauty, the extra effect introduced by the digital filter (e.g., enlarging the eyes, narrowing the chin) may make the look deviate from the standard and thus fail to evoke the assimilation effect of upward comparison.

Method

Participants and Recruitment

Two-hundred and five undergraduate female freshmen (Mean age = 19.24) at a university in the central region of China who majored in elementary school education, preschool education, educational sciences, or applied psychology were recruited through in-class announcements about the research participation opportunity. Those who participated in the study were compensated with 40 RMB WeChat payment (about $6 USD). Sixty-eight percent of the participants were from rural areas of China. The father or mother of 24% of the participants had received higher education; 16% were from families in which both parents had received higher education, and for 57%, neither parent received higher education. All participants lived on

campus. Excluding their lodging fee, their monthly living expenses ranged from 200 RMB to 2,500 RMB, with an average of 1,010 RMB. When asked about their perceived family status on a socioeconomic ladder from 1 (being worst off) to 10 (being best off), their responses ranged from 1 to 10, with an average of 4.63 (S.D.=1.57).

Independent Variable Manipulations

Students who were interested in participating were given a two-week window to sign up for the study. The first 150 participants who signed up for the study were randomly assigned to one of the two conditions: an experimental condition and a control condition (regular camera condition). To increase the power of testing hypothesis 3, which focuses exclusively on the experimental condition, the remaining 55 participants who signed up later were all assigned to the experimental condition. Participants in the experimental condition (n=130) were asked to look at themselves as captured by an iPad selfie app with a beauty filter applied, and as a result, exposed themselves to a digitally enhanced image of self. Participants in the control condition (n=75) were asked to look at themselves as captured by the regular front camera of the iPad, and as a result, be exposed to an image of self without digital enhancement.

The selfie app and beauty filter used for the experimental condition were preselected through a rating process conducted with a different group of five college females in a pilot study. These participants for the pilot study were from the same cohort of the same university as participants for the main study. During the pilot study, they were presented with a total of six beauty filters from three different beauty camera applications (Wuta Camera, B612, and Ulike) that were trendy among Chinese college students in 2019. Two filters from each application were included for the pilot, the default beauty filter of the application and a popular beauty filter marked as “hot” or “top-picked”. Participants were asked to try the filters on and rate each filter

on two questions with a 7-point scale: “how much are you satisfied with the effect of this beauty filter?” (1 = not at all; 7 = a great deal); “how much do you dislike or like this beauty filter?” (1 = dislike it a lot; 7= like it a lot). Based on participants’ responses, the B612’s default beauty filter was chosen for the main study as it generated the most satisfying effect and was most highly liked. Participants were then asked to reflect on what they like about this filter. The most common response elicited was that this filter brought an obvious enhancement to their look without looking fake or unreal. A demonstration of the effects of the chosen beauty filter was provided in Figure 1. Several changes made by the beauty filter to one’s look can be observed, including changes to the skin (remove pimples and blemishes, smooth wrinkles, even out and lighten the skin tone), facial shape (slim the face, narrow the chin), eyes (enlarge the eyes, remove the circles), nose (narrow and lengthen the nose, reduce the alar) and mouth (make the mouth smaller and lips fuller). It also applies some make-up effects to the look including eyebrow color, blush and lip color).

Measures

Outcome variables:

Implicit Self-esteem. The Implicit Association Test (IAT) was used to measure participants’ implicit self-esteem (Greenwald et al., 1998; Greenwald & Farnham, 2000). The IAT has been widely used to examine unconscious attitudes that are typically influenced by social desirability (Greenwald et al., 2003).

The IAT is a computer-based, response-mapping procedure that measures the extent to which respondents associate the self with positive and negative words. Participants sorted words as quickly and as accurately as possible, along two dimensions: pleasant versus unpleasant words (i.e. pleasure, gloom) and self vs others (i.e. me, them). The target words appeared in the center

of the screen, and the category labels appeared in the upper left and right corners of the screen. Participants were asked to place the stimuli into the correct category with special emphasis on haste and accuracy using the "E" (i.e. category on the left) and "I" (i.e. category on the righty) keys on the keyboard to indicate the category. The underlying logic of the IAT is that individuals with high implicit self-esteem (i.e., strong associations between the self and positive words) will respond faster and more accurately.

Participants completed a total of seven trials. Trials 1, 2, and 5 were practice trials for which participants make single categorizations (pleasant vs. unpleasant or self vs. other). In the remaining blocks, participants made both sets of categorizations, during which the combination of the target object and evaluative statement were reversed (e.g. self +pleasant, then self +unpleasant), as was the position of the bins on the screen (i.e., left or right). Within each block, words were presented in random order. Implicit self-esteem was expressed as a standardized value reflecting the direction and the magnitude of the association between self and the positive and negative attributes. This value can range between -2 and +2, with higher values indicating higher state self-esteem. Responses that were incomplete or that had an overall accuracy rate lower than 80% were omitted from data analyses. The Chinese version of the test has been widely used in research investigating Chinese college students' implicit self-esteem (e.g. Boucher, Peng, Shi, & Lei, 2009).

State positive affect. To assess task-specific state positive affect, participants completed the positive affect subscale of an abbreviated version of the Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988; Qui, Zheng and Wang, 2008) after exposure to the self-image appearing on the iPad screen with/without digital enhancement. The PANAS required participants to rate how they felt during the evaluation of the selfie apps (i.e., exposure to self-

image) on a set of ten positive emotion words, including excited, active, and enthusiastic. Specifically, the instructions were: “Please use the following words to describe the feelings and emotions you experienced when you evaluate the effects of the selfie app.” Responses were rated on a 5-point scale (1= “not at all” and 5 = “extremely”). The Chinese version of PANAS was translated and revised by Lin, Zheng and Wang (2008). It had good internal consistency and correlated well with peers’ evaluation of participants’ affects. For the current sample, the Cronbach α for the positive affect subscale was .94.

State Appearance Self-esteem. State appearance self-esteem was measured by the Appearance subscale of the State Self-Esteem Scale (Heatherton & Polivy, 1991). The scale was developed to be sensitive to temporary fluctuations in self-esteem, rather than as an index of stable and habitual levels of self-esteem. The Appearance subscale consists of 6 items, rated on a 5-point Likert scale (1 = “not at all”; 5= “extremely”). Example items include “I am pleased with my appearance right now” and “I feel unattractive” (reversed item). Scores were averaged to create an overall score of state appearance self-esteem. The appearance self-esteem subscale has been widely used in studies of appearance comparison and revealed good reliability (Want, 2009). For example, the Cronbach α was .92 in Leahey and Crowther’s study (2008) and .87 in Tiggemann et al.'s study (2009). The scale was translated into Chinese by the author, then back-translated by another Chinese-speaking researcher in psychology. Any discrepancies with the original English version were resolved by a group of three Chinese researchers who have received academic training in the United States. For the current sample, the Cronbach α was .67. Examination of the scale revealed that two items focusing on satisfaction/dissatisfaction with body size/shape had lower than average correlation with rest of the items. Because the study was not focusing on satisfaction with body size/shape but facial appearance, which is typically the

main subject of a selfie, these two items were removed from the scale, resulting in an improved Cronbach α of .705.

Other variables:

Fixed vs. malleable view of physical appearance. To assess individual differences in implicit theories of beauty, Burkley et al.'s (2014) 4-item measure of Implicit Theories of Beauty was used. This measure is modified after Chiu and colleagues' (Chiu, Hong, & Dweck, 1997) general measure of implicit theories. Specifically, the 4 items assessed the extent to which participants perceive beauty as fixed or malleable (e.g., "People who are born without natural beauty can't do much to change that"). Responses were rated on a 6-point scale, from 1 = "strongly disagree" to 5 = "strongly agree." Scores were summed to produce a total score. The Cronbach's α was .79 in Burkely et al.'s (2014) study. The scale was translated into Chinese by the author, then back-translated by another Chinese- speaking researcher in psychology, with any discrepancies with the original English version resolved by the group of three Chinese researchers who have received academic training in the United States. The Cronbach's α was .614 for the current sample.

Perceived level of digital enhancement. For participants in the beauty camera group, the perceived level of digital enhancement was measured using a single item following the manipulation check question of "Do you think the camera you just used was in beauty mode?". On a 5-point scale, participants were asked "How much does the beauty filter enhance your look?", with 1 being "not at all" and 5 being "a great deal."

Baseline appearance satisfaction. Baseline appearance satisfaction was measured using the appearance subscale of Harter's (1988) Self-Perception Profile for Adolescents. Chan (1997) tested the Chinese version of the scale among Chinese adolescents in Hong Kong and found

good validity and reliability of the appearance subscale (Cronbach's α was .79). Two modifications to this subscale were made in the current study. First, the current study took the question format of Wichstrøm's (1995) revised version of the scale. The original question format (Harter, 1988) presents participants with descriptions of two adolescents with opposite characteristics on each item (e.g. "Some students are not happy with the way they look BUT Other students are happy with the way they look"). It asks the participants to first identify which one of the two types of adolescents is most similar to them and then to indicate whether the description is really true or sort of true for them. Wichstrøm's version turned each item from the original style into an ordinary question (e.g. "I am happy with the way I look") rated on a 4-point scale (1= Describes me very poorly; 4=Describes me very well). Wichstrøm (1995) found better factorial, assumed convergent, and discriminant validity of this version than the original one. Whereas the Cronbach's α was .76 for the appearance subscale in the original version, the Cronbach's α was .87 (Wichstrøm, 1995). Second, an additional item asking specifically about participants' satisfaction with facial appearance (i.e. "I'm satisfied with my facial appearance") was added to the scale. Scores on each item were summed to produce a total score. The Cronbach's α is .782 for the current sample.

Dispositional Positive Affect. Dispositional affect is measured using the Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988). Participants were instructed to rate ten positive emotion words on a 5-point scale ranging from 1 (not at all) to 5 (extremely) based on how they general feel/how they feel on average. The Cronbach α for this scale was .887.

Trait self-esteem. Trait/baseline self-esteem was measured using Rosenberg's 10-item, Self-Esteem Scale (Rosenberg, 1965). An example item is "On the whole, I'm satisfied with

myself." Responses were rated on a 4-point Likert Scale (from 1 = "strongly disagree" to 4 = "strongly agree"). The scale was first translated into Chinese by Ji and Yu (1993) and has been widely used to study Chinese populations. However, there has been some controversy regarding the translation and the scoring of the reverse item of "I wish I could have more respect for myself." Lin and Huang (2009) revisited this scale to evaluate how different ways of translation and scoring of this item can influence the scale's validity and reliability. The best version they came up with had high validity, a reliability of .849 and was negatively correlated with anxiety and depression. The Cronbach's α was .837 for the current sample using Lin and Huang's best version of translation.

Narcissism. Narcissism was measured using the NPI-16 Subclinical Narcissism Scale (Ames et al., 2006). It is a short version of the most widely used, 40-item Narcissistic Personality Inventory (Raskin & Terry, 1988) and is designed for nonclinical populations. Participants were provided with 16 pairs of statement and asked to choose one statement from each pair that comes closest to describing their feelings and beliefs about themselves (e.g., "I really like to be the center of attention" vs. "It makes me uncomfortable to be the center of attention"). A score was computed representing the proportion of responses consistent with narcissism. The scale had notable face, internal, discriminant, and predictive validity and had a Cronbach's α ranging from .68 to .78 (Ames et al., 2006). NPI-16 was translated into Chinese, tested and adjusted by Li, Li and Wang (2012). The Chinese version of the scale had good validity and a Cronbach's α of .670. For the current sample, the Cronbach's α is .494. After a close examination of the scale, the item of "I usually get the respect I deserve VS I insist upon getting the respect that is due to me" was first removed, which resulted in a Cronbach's α of .580.

Objective rating of physical attractiveness. The two research assistants overseeing the experimental sessions independently rated participants' physical attractiveness on a 5-point scale with the middle point being "around average." The ratings were averaged to generate a single score. The interrater reliability was .857 (p <0.001), 95%CI (.812, .892).

Procedures

The experimental procedures of the current study were designed based on Ferguson's (2013) suggestions of avoiding and alleviating methodological issues common to studies on media effects on appearance concerns, especially demand characteristics and introduction of confounding variables. Specifically, a two-step design with a cover story was used in an attempt to disguise the nature of the experimental manipulation. Participants were informed that they needed to participate in two studies to get the monetary compensation: a survey on their self-concept which would take place online and a study on Chinese students' use of selfie apps, which would take place in a computer lab. Baseline/trait variables were measured in the online survey, which took place a week before the lab visit. The experimental manipulation was performed during the lab visit and accompanied by a survey including outcome measures and other questions related to their selfie behaviors,

This arrangement had several benefits: First, having participants believe there were two studies made it more challenging for the participants to guess the real purpose of the study and the hypotheses. Second, since participants were told the second study was about their use of selfie-apps, it created a great opportunity to disguise the experimental manipulation (exposure to a self-image with/without digital enhancement). During this portion of the study, participants were asked to perform a blind test of a camera app on an iPad, which created a natural opportunity to expose participants to a self-image with/without digital enhancement. Third,

outcome measures of implicit self-esteem, task-specific affects, and state self-esteem of physical appearance were embedded among distracter questions that were consistent with the cover story (e.g. evaluating the selfie app's resolution, color tone), further reducing demand characteristics within the experiment. The rest of this section will be used to describe the details of the study procedures.

Participants were asked to fill out the online survey of physical self-concept first. At the end of the survey, they were directed to a separate webpage to schedule their lab visit for the study on college students' selfie app use, which took place about a week later. No more than seven participants were scheduled per time period. For the first 150 participants who were randomly assigned, the lab was set up to have a mixed of both conditions for each timeslot. For the additional 55 participants, all seating in the lab was set up as experimental condition.

Upon their arrival at the computer lab, participants were welcomed by two trained research assistants, who helped the participants sign into the study with an orientation and an informed consent form.

Then, participants were seated at separate cubicles fitted with desktop computers. Seating was arranged in a way that participants were not able to interact with each other throughout the lab session. Participants were told that, for the lab session, they would first complete a remaining component of the self-concept study (two rounds of word association test related to self-concept) and then move onto the study on use of selfie apps.

After the first round of the word association test (i.e., pre-intervention implicit association test of self-esteem), participants were asked to take a short break, during which they were asked to help check the equipment for the selfie app evaluation. The so-called equipment check involved the following steps: first, the participant were asked to retrieve an iPad that was

previously hidden under a piece of paper on a chair next to the participant; second, the participants were asked to grab the iPad as if they were taking a selfie with it and check (a) if the front camera was open; (b) if the selfie app occupied the full screen; and (c) if there was a good amount light so the face showing on the screen was neither too dark nor too bright. Through this equipment check, the experimental manipulation was executed – participants were exposed to either a self-image with or a self-image without digital enhancement. For participants in the control condition (i.e., self-image without digital enhancement), the iPad was in sleep mode with the regular front camera open. For participants in the experiment condition (i.e. self-image with digital enhancement), the iPad was in sleep mode with a selfie app open and a beauty filter applied. The selfie app and beauty filter used for the experimental condition were preselected through a rating process conducted with a different group of five college females in a pilot study. The filter that generated the most satisfying effect and was most widely liked by these students was chosen. Participants in both conditions were not informed if their assigned selfie app was in the beauty mode. All identifying features of the regular camera and the beauty camera app including the shutter button were covered with pieces of tape. Therefore, participants were never asked to take a picture during the entire process. Other functions of the iPad (e.g. switch to a different page/app) were disabled throughout the lab visit to make sure participants were not distracted. The equipment check was followed by the second round of word association test (i.e., post-intervention implicit association test of self-esteem).

In the next step, participants were informed that the study on college students' selfie app use would start with a blind evaluation of the effects of the iPad selfie app assigned to them. To draw participants to their self-image showing on the screen, the participants were told that in the upcoming evaluation survey, they would be asked about whether they liked the resolution

and color tone of the camera and whether they would consider using it for taking selfies if they had it installed on their own devices. The experimenter then gave another 15 seconds to the participants to examine these aspects of the camera. This step constituted another experimental manipulation. After this exposure to their self-image, participants were asked to fill out a survey, which included deceptive questions evaluating the effects of the assigned selfie app as mentioned earlier, questions about their state appearance self-esteem, state affect and selfie taking and editing behaviors. The manipulation check question was also included in this survey.

Before the participants left the lab, they were asked to provide their email address for receiving additional information about the study. They were then thanked and given the monetary compensation. The two research assistants rated each participants' physical attractiveness covertly and independently on the 10-point scale during the participants' lab visit.

At the end of the data collection, a debriefing email was sent to participants. They were asked to indicate whether or not they were suspicious of the real goal of the study. Data collected from suspicious participants would be eliminated from the analyses.

The sequence of steps involved in the experiment is summarized in Figure 2.

Data Analysis plan

First, a manipulation check was performed to determine whether the participants perceived the digital enhancement to their look as manipulated in the stimuli with the chosen beauty filter. Preliminary analyses were conducted to examine the internal consistency of the measures and the distribution of variables with the entire sample.

H1 and H2 were then tested with the random assigned sample of equal size, 75 participants for each condition. A Student's t-test was first carried out to examine if there were differences in baseline/trait measures between the experimental group (beauty camera condition)

and the control group (regular camera condition). Then three separate hierarchical multiple regression analyses were run, one for each outcome variables.

Each regression model followed four major steps. In step 1, the baseline measure for each outcome variable was added to the model. Potential covariates, including baseline appearance satisfaction, trait self-esteem, narcissism and disposition positive affect were also added to the model in this step if the variable was actually significant in adjusting a dependent variable (Tabachnick and Fidell, 1989) and adding it was not causing multicollinearity. In step 2, the intervention condition dummy (0=regular camera; 1=beauty camera) was used as the predictor for outcome variables while controlling for corresponding baseline measures. When substantial interaction between the independent variable (experimental condition) and a potential covariate/baseline measurement was detected, this variable would be included in the main analysis along with an interaction term. These steps examined the main effect of exposure to enhanced image of self (H1). In step 3, malleable view of physical appearance was entered into the model, followed by the interaction term between it and the independent variable entered at step 4. These two steps helped examine whether the relationships between exposure to self-image and outcome variables of state physical appearance self-esteem and state affects differed according to the value of fixed vs. malleable view of physical appearance (H2).

To address H3, data collected from the additional 55 participants were first compared to that from the 75 participants who were randomly assigned to the experimental condition to determine their equivalence in demographics and baseline measures. Then the data were merged (n=130) to test the hypothesis with hierarchical multiple regression analyses. For these analyses, control variables were entered at step 1 and the perceived enhancement level entered at step 2. All hierarchical multiple regression analyses were conducted with SPSS version 26. To assess

the fitness of models, the Adjusted R-squared and the F-value were obtained, with higher value indicating better model fitness.

Lastly, the study took an additional step to examine the change in implicit self-esteem from pre- to post- with hierarchical linear modeling (HLM; Bryk & Raudenbush, 1992; Raudenbush, Bryk, Cheong, & Congdon, 2000). HLM is an appropriate statistical analysis for pre- and post-data as it can examine if within-subject changes are related to between-subject characteristics, such as the intervention condition (enhanced versus regular selfie group), mindset of physical appearance, and perceived enhancement level. For HLM models, time (pre-intervention=0, post-intervention=1) was entered at level-1, with the score on implicit self-esteem test being the dependent variable; between-subject factors such as intervention condition (0=regular camera, 1=beauty camera) were entered at level-2. All HLM models were run with HLM 8 Software.

Results

Manipulation Check

As a check on the manipulation (digital enhancement with beauty filter), participants were asked if the camera app assigned to them was in beauty mode or not. Ninety-three percent of participants in the beauty camera condition answered “yes” to this question whereas 8% of participants in the regular camera condition did so. I also calculated the mean perceived level of digital enhancement reported by the participants in both conditions. On a scale from 1 to 5, participants in the beauty camera condition perceived the level of digital enhancement as significantly higher (M=2.58, SD=.815) than participants in the regular camera condition (M=1.36, SD=.61), t = -12.038, $p < .001$. After receiving the debriefing email, no participants indicated that they were suspicious of the purpose of the study.

Preliminary Analyses

Bivariate correlations between primary variables were calculated and reported in Table 1. These correlations give rise to several noteworthy observations. First, outcome variables of state physical appearance self-esteem, state positive affect, and implicit self-esteem after the intervention were intercorrelated. However, post-intervention implicit self-esteem was not correlated with any other outcome variable. Indeed, post-intervention implicit self-esteem was only correlated with pre-intervention implicit self-esteem among all these variables. Second, objective rating of physical appearance was related to none of the baseline or outcome variables. Third, each of the outcome variables correlated most strongly with their corresponding baseline variable. These baseline variables were controlled in step 1 in the following hierarchical multiple regression analyses.

Hypothesis 1

Participants in the two conditions did not differ significantly in terms of demographics, including age $t(143)=1.841$, $p= .068$, perceived social economic status $t(144)=-.0926$, $p= .356$, parental education level $t(144)=0.148$, $p= .883$ and BMI $t(148)=-.018$, $p= .986$. In terms of baseline/trait and objective measures, participants in the beauty camera condition reported slightly higher trait self-esteem, $t(145)=-3.214$, $p=0.002$ and higher pre-intervention implicit self-esteem, $t(146)=-3.127$, $p=0.002$ (see Table 2). There were no significant differences in terms of baseline satisfaction with physical appearance, dispositional positive affect, narcissism, and fixed vs. malleable mindset of physical appearance.

In terms of outcome measures, on average, participants in the beauty camera condition reported higher state physical appearance self-esteem, state positive affect, and implicit self-esteem than participants in the regular camera condition after seeing their self-image

with/without digital enhancement. Means, standard deviations for the three outcome variables in each condition along with the standardized mean differences between the conditions are presented in Table 3. Regression analyses were then performed to test if these differences were significant, controlling for baseline physical appearance satisfaction and potential covariates.

State physical appearance self-esteem. Baseline satisfaction with physical appearance and trait self-esteem were entered into the hierarchical model as control variables in step 1. Both variables were positively associated with state physical appearance self-esteem and have no interaction with intervention condition. Together, control variables accounted for 28.2% (adjusted R^2= .272) of the variance in the outcome, $F(2,142) = 27.953$, $p < .001$. None of the other potential covariates was significant in adjusting state physical appearance self-esteem and therefore not included in further analyses.

Intervention dummy was then entered into the model as step 2. Consistent with H1, after adjusting for baseline physical appearance satisfaction and trait self-esteem, participants who saw an enhanced image of self in the beauty camera condition experienced higher state physical appearance self-esteem than those who saw a self-image without enhancement in the regular camera condition ($\beta = .169$, $p = 0.021$). Adding the intervention dummy explained an additional 2.7% of the variance in state physical self-esteem (adjusted $R^2 = .295$), $\Delta F\ (1,141) = 5.488$, $p = .021$ (Table 4.1).

State Positive affect. None of the potential covariates significantly improved the model when added into the analysis. Dispositional positive affect was entered into the hierarchical multiple linear regression analysis as step 1, accounting for 10.6% (adjusted $R^2 = 0.099$) of the variance in post-exposure state positive affect, $\Delta F\ (1,141) = 16.642$, $p < .001$. Participants with higher dispositional positive affect reported higher state positive affect after the intervention

condition dummy was added to the model in step 2, explaining an additional 4.3% of variance in state physical self-esteem (adjusted $R^2 = 0.136$, ΔF (1,140) = 7.030, $p = .009$). Controlling for dispositional positive affect, seeing a digital enhanced image of self was related to higher state positive affect than seeing an image of self without digital enhancement ($\beta = .208$, $p = 0.009$). This result is consistent with H1.

Implicit self-esteem. Pre-intervention implicit self-esteem was entered into the regression model as step 1, which accounted for 22.4% (adjusted $R^2 = .219$) of the variance in post-exposure implicit self-esteem, ΔF (1,145) = 41.919, $p < .001$. Pre-intervention implicit self-esteem was positively correlated with the post-intervention implicit self-esteem. Inconsistent with the hypothesis, adding intervention status into the model as step 2 failed to improve the model, ΔF (1,144) = 1.026, $p = .313$. There was no significant difference in post-intervention implicit self-esteem between the beauty camera condition and regular camera condition (β = -.077, p =0.313), controlling for pre-intervention implicit self-esteem. None of the potential covariates made an additional contribution to explaining the variance of the outcome variable and therefore not included in the model.

HLM analyses were then performed to understand how implicit self-esteem changed from pre- to post-intervention and if the change varied by intervention condition. Time of taking the implicit self-esteem test was dummy coded, with pre-intervention coded as 0, post-intervention coded as 1. Intervention conditions were also dummy coded, with 0 being regular camera condition and 1 being beauty camera condition. The following level-1 and level-2 equations were used:

Level 1: $ISE_{ij} = \beta_{0j} + \beta_{1j} * (Time_{ij}) + r_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01} * (Intervention_j) + u_{0j}$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} * (Intervention_j)$$

Mixed model: $ISE_{ij} = \gamma_{00} + \gamma_{01}(Intervention)_j + \gamma_{10} * Time_{ij} + \gamma_{11} * \left(Intervention_j\right) *$

$$Time_{ij} + u_{0j} + r_{ij}$$

The results showed that implicit self-esteem got lower after exposure to self-image γ_{10} = -0.073, t (145) = -2.012, p = 0.046. Participants in the beauty camera condition experienced a larger decrease in their implicit self-esteem than participants in the regular camera condition, as indicated by the statistically significant interaction between the intervention and time on implicit self-esteem γ_{11} = -0.145, t (203) = -2.814, p = 0.006. Figure 3 illustrates the mean changes in implicit self-esteem for both conditions from before to after the intervention.

Hypothesis 2

Participants in the randomized samples held a relatively malleable mindset of physical appearance (M = 4.664, N=149, SD = .687). Subsequent analyses treated this measure as continuous, but for descriptive purpose, we used the midpoint of the scale value as a cutoff and found that 3.4% of the participants (N = 5) held a fixed view of beauty, 93.3% of the participants (N =139) held a malleable view of beauty, and 3.3% were undecided (i.e., scored at the midpoint).

The hypothesis that mindset of physical appearance would moderate the relationship between intervention condition – looking at oneself as captured by a beauty camera or regular camera – and outcome variables was not supported. Adding the variable of physical appearance mindset and its interaction term with intervention condition into the models identified earlier as step 3 and step 4 respectively did not explain additional variance in any of the three outcomes. Neither the variable itself nor the interaction term was significantly associated with the outcomes. Details of the results are reported in Table 4.1-4.3.

Hypothesis 3

The additional 55 participants in the experimental condition did not differ significantly from the first 75 participants who were randomly assigned to the experimental condition in any of the demographic and baseline measures (Table 5). The data were therefore merged for testing Hypothesis 3.

Participants in the beauty camera condition on average perceived that the selfie app applied "a little" to "a moderate amount" of enhancement to their look (M=2.58, SD=.815). There were eight participants who reported that the selfie-app did not enhance their look at all. For these participants, the image generated by the beauty filter was not serving as an upward comparison target, so there was no basis for the assimilation effect being hypothesized here to occur. These cases were therefore deleted from further analyses.

Results of hierarchical regression analyses (Table 6) did not support H3. Controlling for trait self-esteem, mindset of physical appearance, narcissism, objective rating of physical appearance, and the corresponding baseline measure, perceived level of digital enhancement was not associated with post-intervention implicit self-esteem (β = .067, p = 0.443); and it was positively associated with post-intervention state appearance self-esteem (β = .244, p = 0.004) and state positive affect (β =.221, p = 0.016).

Discussion

Impacts of virtual make-over use

The findings of the study provide important evidence concerning the question of whether and how virtual makeover use affects Chinese college female's evaluation of self. Analyses indicated that exposure to a selfie with digital enhancement elicited asymmetric changes in explicit and implicit self-evaluations.

More specifically, the study revealed that, compared to those who saw a self-image without digital enhancement, participants who saw an image of self with digital enhancement reported higher state physical appearance self-esteem and state positive affect. From the perspective of upward comparison theory(Collins, 2000; Lockwood & Kunda, 1997; Mussweiler, 2003), the airbrushed image of self served as a potential future self to which the Chinese college students were motivated to assimilate. In other words, use of virtual makeover invited these young females to foster a fantasy of having a prettier look, which led to a more positive explicit evaluation of self and more positive moods. This finding fits well with the proposition of upward comparison theories that upward comparison can have inspiring and enhancing effect when the similarities between the self and the comparison target are more apparent than the dissimilarities. It also provides support for the association between selfie manipulation and positive self-concept found by Meng et al. (2017) in their correlational study. Analyses also indicated that the impact of the virtual makeover use on self-evaluation was not moderated by any of the baseline and trait variables, including baseline physical appearance satisfaction, dispositional positive affect, pre-exposure implicit self-esteem, trait self-esteem and narcissism.

On the other hand, however, no positive impact of beauty filter use was found for implicit self-esteem. There was no significant difference in the post-intervention implicit self-esteem between participants in the beauty camera condition and those in the regular camera condition. One potential reason lies in the measure of implicit self-esteem. General self-esteem, rather than domain-specific self-esteem, was assessed in the current study. It is possible that assimilation to a digitally enhanced selfie only affected positive thoughts within the specific domain of physical appearance. Another potential explanation is that because implicit and explicit self-esteem

operate through different cognitive systems (Grumm et al., 2009). Whereas explicit self-esteem is attained through rule-based conscious processing of self-relevant information and is highly adaptable to currently considered knowledge; the implicit self-esteem is regarded as the product of automatic, intuitive processing, which is characterized as activation of association in memory. These two systems might be influenced differently by exposure to an enhanced look of self.

Further analyses of the data showed that participants in both conditions experienced a drop in their implicit self-esteem, suggesting that *assimilation* may only account for the self-relevant information processing on the explicit level. As mentioned earlier, focusing the attention on oneself could activate an automatic comparison of one's present condition with relevant standard (Ickes et al., 1973; Silvia & Phillips, 2013). Exposure to one's self-image, regardless of whether the image is filtered or not, will arouse self-focused attention on physical appearance, which may render the discrepancy between one's look and the unattainable societal standard of beauty in one's memory accessible and contributes to an impaired implicit self-esteem.

The unanticipated finding of the sharper drop in implicit self-esteem experienced by participants in the beauty camera condition is tricky to explain without further investigation. Here, I discuss two speculations. First, scholars ((Mussweiler, 2003) have suggested that the same comparison can elicit both assimilation and contrast effect simultaneously. It is possible that while an assimilation effect occurred on the explicit level, as people deliberately aligned themselves to the filtered look to feel good, a contrast effect occurs on the implicit level, as the effect of the beauty filter, a vivid remainder of the beauty standard, activated people's perceived discrepancy between their actual look and the desired look back their mind. Second, for the current sample of the study, participants in beauty camera group on average had higher pre-intervention implicit self-esteem. The more drastic drop in implicit self-esteem experienced by

these participants may simply due to a more abrupt regression to the mean. Future studies are warranted to test out these speculations.

Individual differences

Based on review of upward social comparison theories and existing studies on appearance comparison, the study proposed two individual-level factors that might alter the impact of exposure to a digitally enhanced image of self: mindset of physical appearance and perceived level of digital enhancement.

The rationale for hypotheses regarding these two individual-level factors was that, when seeing a filtered selfie, college females with a more malleable view of physical appearance and those who perceive lower levels of digital enhancement are more likely to view the enhanced image as attainable. Previous studies (Lockwood & Kunda, 1997; Mills et al., 2002) have suggested that when the excellence of an upward comparison target is viewed as attainable, it can be inspiring and lead one to view oneself more optimistically. It is therefore hypothesized that people with a more malleable view of physical appearance would have more positive self-evaluations and mood after viewing a selfie with virtual makeover; perceived level of digital enhancement would be negatively related with self-evaluation and moods. However, neither of these two hypotheses was supported by statistical analyses.

In terms of mindset of physical appearance, results show that its interaction with beauty filter use was not significant in predicting post-exposure self-evaluation and positive affect. The insignificance of the results, however, should be interpreted with caution. First, it is worth noting that the measurement of mindset of physical appearance had rather marginal internal consistency. Therefore, the absence of a significant moderation effect might also be the result of measurement error.

Second, in this study, mindset of physical appearance was treated as quantitative, with higher value indicating a more malleable view of physical appearance. The analysis was performed based on the assumption that mindset of physical appearance linearly changes the causal relationship between beauty filter use and outcome variables. Yet, there is a possibility that the responses on the scale of physical appearance mindset fell into two qualitatively different segments: fixed view of physical appearance and incremental view of physical appearance; and it is this qualitative difference rather than the quantitative variance within each end (e.g., whether one agrees with the statement of "physical appearance can be improved" a little or a lot) that alters people's psychological reactions to a filtered look.

One way to test this speculation is to categorize the data on this variable into binary format. But the current sample's distribution on this variable poses a challenge in adopting this approach. If the midpoint of the scale value is deemed as the basis for splitting the data, the great majority of participants belonged to the incremental theory group, leaving a very small number of cases to the fixed theory group. The lack of variation in the binary data makes it hard to accurately estimate its relationship with other variables.

To avoid this potential pitfall in future studies, researchers should consider including an external manipulation on mindset of physical appearance instead of relying on the ongoing individual differences. For example, researchers could follow the paradigm derived by Burkley et al. (2014) in their study on fixed vs. malleable beliefs of beauty. In this study, participants were randomly assigned to read one of three articles– a fixed condition article that highlight the fixed nature of beauty (e.g., "no matter how much efforts you make, it is still hard to look as attractive as those who won a genetic lottery"; "beauty is rather fixed and does not significantly change over time"), a malleable condition article that highlight the malleable nature of beauty

(e.g., “there is no ugly lady, only a lazy lady”, “beauty is rather malleable and can be significantly improved”) and a control condition article that is irrelevant to beauty. In this way, the levels of the variable are changed systematically so that people in different group scored differently on this variable.

In terms of perceived level of digital enhancement, its association with outcome variables found in this study was in the opposite direction of the hypothesis. The results show that, for participants in beauty camera condition, the higher level of digital enhancement they perceived, the higher their post-exposure state physical appearance self-esteem and state positive affect were. This finding might be related to the fact that, in this study, every participant in the beauty camera condition used the same beauty filter, which was pre-selected during a pilot study. The winning filter was the one rated as providing the most satisfying effect. Since people have the tendency toward authenticity in their self-presentations (Leary & Kowalski, 1990; Schlenker & Pontari, 2000), it is likely that the filter chosen for this design did not provide the most enhancement but rather the most natural enhancement. Therefore, it could be case that even those who reported perceiving a lot of digital enhancement still viewed the enhanced look as well within their reach. Moreover, as the use of beauty filter for selfie-taking has become a social norm among Chinese young females, these college students may have grown accustomed to the enhancement effect. For them, the higher perceived enhancement level did not signal the discrepancy between the actual self and filtered self nor difficulties in attaining the attractiveness in real life; instead, it may indicate a higher desirability of the filtered look and greater potentials for self-improvement, which in turn heighten the positive consequences of assimilating to the comparison. This finding leads to a research question that should be investigated in the future to further the understanding of the mechanisms accounting for the impact of upward social

comparison. That is, when the upward comparison target is viewed as attainable, will the assimilation effect be stronger if the target is viewed as more likeable/attractive/successful? For example, a graduate student, Brian, is introduced to two role models in his field. Both of them share a great deal of similarities with Brian in terms of family background, educational trajectory, etc. But they are more advanced and successful in their career than Brian, so they can both serve as his upward comparison target. Due to the shared similarities, Brian feels he can envision himself following either of the two's path to success. Now, if role model A is perceived by Brian as the more successful one out of the two, will comparing himself to role model A elicit a more positive impact on Brian's self-evaluation than comparing himself to role model B?

Limitations and Future Directions

The present study is the first of its kind. Besides what has been mentioned in the discussion, some other limitations of the study should be acknowledged, again with respect to identifying directions for future research.

First, to limit testing effects, the current study did not apply repeated measures for the outcomes of state appearance self-esteem and state positive affect. As a result, the data collected for this study did not allow for examination on intra-individual level of pre-post changes in these variables across the conditions. Researchers could consider applying randomized Solomon four-group design to evaluate separately the magnitudes of intra-individual change and between-individual differences caused by the treatment and pretesting to get a more comprehensive understanding of the impact of virtual makeover use.

Second, the study hypothesized that the participants' mindset of physical appearance and perceived level of digital adjustment would change the impact of exposure to enhanced self-image via influencing their perceived attainability of the enhanced look. However, the mediating

role of perceived attainability was only assumed and remains to be empirically examined. Future studies with a direct assessment or manipulation on the key variable of perceived attainability would allow further testing of the hypotheses derived from social comparison theory.

Third, the study examined the short-term effect of exposure to digitally enhanced self-images in a lab setting. Participants were looking at their selfies with or without digital enhancement to cooperate with an ostensible blind evaluation of selfie apps and not for their normal purposes of use. It is uncertain if the effect found in this study can be generalized to real-life circumstances and how subjects' self-evaluation would fluctuate over time following their use of beauty filters. Studies applying ecological momentary assessment (EMA) can contribute to understandings on both fronts. Such approach would also allow researchers to investigate how other individual factors (e.g., motivations of beauty filter use) and contextual factors (e.g., peers' reaction to the edited photo) might influence the fluctuation in individuals' self-evaluation and mood following their use of beauty filter.

Fourth, this study did not consider the potential moderating influence of the affordances and features of different beauty filters on the impact of exposure to filtered self-image. For example, some filter apps provide a "before and after" filter contrast once a photo is taken with the app, making the differences between the actual look and the filtered look salient. Will this feature prevent people from assimilating to the filtered look? What if there is no "before and after" contrast, but a watermark on the produced photo indicating it is filtered? Studies exploring these questions will provide a more comprehensive understanding on the influence of automatic beauty filters on young females' self-image.

Last but not least, the study was conducted with a college sample. It is unknown if the results can be generalized to other age groups. Developmental characteristics such as self-

consciousness, self-concept clarity and digital literacy may play a significant role in influencing people's attitudes and reactions to virtual makeover use. Moreover, people's psychosocial reactions to virtual makeover use may depend on cultural factors such as attitudes toward physical appearance and selfie-editing behaviors, the results of the study could be culturally specific. This study was carried out in China, where there is a broad acceptance of one's capacity to alter one's image for the sake of posting on social media. Also, as shown in this study, an overwhelming proportion of Chinese college females held a malleable view of physical appearance. It raises the question of whether people with a fixed view of physical appearance or living in a culture where alterations to digital presentation of self are discouraged would experience the same assimilation effect as found in this study when they use beauty filters. The findings of the study should therefore be validated in in other cultures and with different age groups to find cultural and age differences manifested in the impact of virtual makeover use.

Contributions and Implications

With an experimental design, this study contributed to the understanding of the impact of virtual makeover use on Chinese college females' self-evaluation and positive moods. Despite its limitations, this study has implications on several fronts.

Theoretically, this study extends the application of social comparison theory to examine the impact of seeing a digitally enhanced selfie generated by an automatic beauty filter on self-evaluation by considering the "better-looking" self as the comparison target. It suggests social comparison theory as a promising framework for future investigation on a novel type of comparisons facilitated by the advancement of technologies: the comparison between the real self and idealized images or profiles or avatars that users create in the virtual world (Lemenager et al., 2020). Second, the study provided some evidence for the theoretical claim that the

evaluative consequences of upward comparison are not always negative. Exposure to an airbrushed image of self, which constitutes a comparison target that better aligned with the societal beauty standard while not being very different from one's look in real life, leads to positive explicit self-evaluation and moods. Third, the lack of evidence for an assimilation effect on implicit self-esteem underscores the possibility for a divergence in the implicit and explicit psychological processes following the exposure to a digitally enhanced selfie. It emphasized the need for future research to integrate social comparison theory with other related frameworks such as dual models of social information processing (Grumm et al., 2009) to untangle the complex array of responses that people can have when processing this self-relevant information.

From a methodological perspective, the study design singled out exposure to a digitally enhanced selfie from other related selfie behaviors (e.g. selfie-taking, manually editing, selecting and posting) and tested its effects in a controlled lab setting. The experimental design allows for drawing causal inference, which is an important addition to the existing literature on selfie behaviors that mainly employed correlational measures.

Practically, people working with college students who are obsessed with selfie manipulation may derive useful insights from the findings. The study suggested that a potential reason that drives young females to use beauty filters is the temporary positive feelings about self, which could not be obtained from looking at a mirror or taking a selfie with a regular camera app. However, college students should be aware of the potential risks associated with positive feelings. After all, the enhancement effect is created by digital tools and remains in the virtual world. When the magic disappears, one may find oneself disappointed by one's unfiltered look. In the long run, those for whom the filtered look provides enjoyment and inspiration may

be internalizing an increasingly unrealistic ideal look and therefore becoming at risk for experiencing appearance disturbance and related mental health issues.

Summary and Conclusion

The findings of the study support a direct influence of virtual makeover use on Chinese college females' explicit evaluations of self. Participants in this study reported higher self-evaluation of physical appearance and positive affect after seeing a self-image with a beauty filter applied than without. However, there is no significant difference in post-exposure implicit self-esteem between those two groups. No evidence was found for malleable vs. fixed mindset of physical appearance as a moderator for the impact of virtual makeover on self-evaluation. For those who saw a self-image with beauty filters applied, the more digital enhancement they perceived, the stronger their explicit positive feelings.

Editing images is not a new phenomenon. But new technologies like the beauty filters have made it more effortless than ever to produce an idealized look of the self. This study showed that the use of these technologies can play a significant, but complicated, role in self-evaluation by featuring a "better-looking" version of self. It makes Chinese college females to explicitly judge their physical appearance in a more positive light but not necessarily improving their unconscious attitudes toward general self. The positive impact on explicit self-evaluation can be toxic, however. It may provoke a feeling that a filtered selfie will make one closer to the societal standard of beauty, whereas the fact is that the standard is always difficult to meet in reality. This study is only the first step in understanding the impacts of virtual makeover use on youth and young adults. There are many more questions are left to be answered. For example, how long will the positive effect on explicit self-evaluation last? Will the impact be found in younger females too? Will the use of virtual filters increase young females' preoccupation with

their look? Will it motivate young females to use real-life filters (i.e., plastic surgery) to improve their look as well? The current study serves as a steppingstone to carry out future studies that address those questions.

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Table 1. Correlations between major variables

		1	2	3	4	5	6	7	8	9	10
1	Baseline physical appearance satisfaction	1	.232**	0.106	.538**	.201**	.205**	0.1	.423**	0.131	0.024
2	Dispositional positive emotion		1	-0.051	.498**	.199**	.165*	-0.042	.233**	.306**	-0.068
3	Pre-intervention implicit self-esteem			1	0.031	-0.093	0.113	0.097	0.13	0.077	.441**
4	Trait self-esteem				1	.377**	.204**	0.026	.395**	.219**	-0.022
5	Narcissism					1	-0.047	0.008	.243**	.149*	-0.055
6	Flexible mindset of physical appearance						1	0.079	.212**	.161*	0.07
7	Objective rating of physical appearance							1	-0.103	-0.104	-0.085
8	State physical appearance self esteem								1	.492**	0.03
9	State positive emotion									1	-0.016
10	Post-intervention implicit self-esteem										1

Table 2. Beauty versus regular camera condition: differences in mean scores on baseline/trait and objective measures

	Regular Camera *N=130*		Beauty Camera *N=75*			
Baseline/trait and objective measures	*M*	*SD*	*M*	*SD*	*t*	*p*
Baseline appearance satisfaction	3.429	0.862	3.636	0.839	-1.475	0.142
Dispositional positive affect	3.290	0.621	3.400	0.553	-1.132	0.259
Implicit self-esteem	0.567	0.287	0.734	0.345	-3.127	0.002
Trait self-esteem	2.750	0.412	2.973	0.429	-3.214	0.002
Narcissism	0.275	0.138	0.302	0.158	-1.098	0.274
Flexible mindset of physical appearance	4.676	0.722	4.653	0.646	0.199	0.842
Objective rating of physical attractiveness	6.100	0.997	6.040	0.961	0.375	0.708

Table 1. Beauty versus regular camera condition: differences in mean scores on outcome measures.

	Regular Camera			Beauty Camera					
Outcomes	*M*	*SD*	*N*	*M*	*SD*	*N*	*t*	*p*	*Standardized Mean difference (SE)*
State physical appearance self-esteem	2.980	.619	75	3.328	.615	74	-3.439	.001	.564 (.167)
State positive affect	2.415	.817	74	2.794	.920	72	-2.637	.009	.408(.167)
Implicit self-esteem	.489	.266	74	.519	.315	74	-0.621	.541	.103(.164)

Table 2.1. Post-intervention State Physical Appearance Self-esteem: hierarchical regression analysis (H1 and H2)

Post-intervention State Physical Appearance Self-esteem								
	Model 1		**Model 2**		**Model 3**		**Model 4**	
	β	*p*	*β*	*p*	*β*	*p*	*β*	*p*
Block 1								
Baseline physical appearance satisfaction	.207	.020	.214	.015	.188	.035	.188	.035
Trait self-esteem	.382	<.001	.336	<.001	.326	<.001	.325	<.001
Block 2								
Beauty camera condition			.169	.021	.177	.015	.287	.567
Block 3								
Malleable mindset of physical appearance					.110	.134	.125	.210
Block 4								
Malleable mindset of physical appearance * Beauty camera condition							-.111	.825
Model Summary	Δ*F*	*p*	Δ*F*	*p*	Δ*F*	*p*	Δ*F*	*p*
	27.953	<.001	5.488	.021	2.276	.134	.049	.852

Table 3.2. Post-intervention State Positive Affect: hierarchical regression analysis (H1 and H2)

Post-Intervention State Positive Affect								
	Model 1		**Model 2**		**Model 3**		**Model 4**	
	β	*p*	*β*	*p*	*β*	*p*	*β*	*p*
Block 1								
Dispositional positive affect	.325	<.001	.305	<.001	.284	<.001	.294	<.001
Block 2								
Beauty camera condition			.208	.009	.214	.007	.690	.210
Block 3								
Malleable mindset of physical appearance					.148	.059	.212	.049
Block 4								
Malleable mindset of physical appearance * Beauty camera condition							-.485	.381
Model Summary	ΔF	*p*	ΔF	*p*	ΔF	*p*	ΔF	*p*
	16.642	<.001	7.030	.009	3.617	.059	.772	.381

Table 4.3. Post-intervention Implicit Self-esteem: hierarchical regression analysis (H1 and H2)

Post-Intervention Implicit Self-esteem								
	Model 1		**Model 2**		**Model 3**		**Model 4**	
	β	*p*	*β*	*p*	*β*	*p*	*β*	*p*
Block 1								
Pre-intervention implicit self-esteem	.474	<.001	.494	<.001	.496	<.001	.501	<.001
Block 2								
Beauty camera condition			-.077	.313	-.078	.308	.797	.128
Block 3								
Malleable mindset of physical appearance					-.023	.751	.089	.367
Block 4								
Malleable mindset of physical appearance * Beauty camera condition							-.890	.092
Model Summary	Δ*F*	*p*	Δ*F*	*p*	Δ*F*	*p*	Δ*F*	*p*
	41.919	<.001	1.026	.313	.101	.751	2.879	.092

Table 5. Randomly versus non-randomly assigned participants in experimental condition: differences in mean scores on demographics, baseline/trait and objective measures

	Randomly assigned *N=75*		Non-randomly assigned *N=55*			
Baseline/trait and objective measures	*M*	*SD*	*M*	*SD*	*t*	*p*
Age	19.14	.954	19.15	.841	-.073	.942
Perceived socio-economic status	4.781	1.575	4.574	1.500	.746	.457
Parental education level	3.210	1.105	3.020	1.248	.886	.377
BMI	20.220	2.093	20.517	2.810	-.692	.490
Baseline appearance satisfaction	3.636	.839	3.747	.891	-.725	.470
Dispositional positive affect	3.400	.553	3.470	.599	-.689	.492
Trait self-esteem	2.973	.429	2.963	.332	.148	.882
Narcissism	.302	.158	.283	.134	.717	.475
Flexible mindset of physical appearance	4.653	.646	4.676	.592	-.203	.840
Objective rating of physical attractiveness	6.04	.961	6.018	1.067	.122	.903

Table 6. Hierarchical regression analyses predicting outcome variables in the beauty camera condition with perceived level of enhancement

	State physical appearance self-esteem				State positive affect				Post-intervention implicit self-esteem			
	Model 1		**Model 2**		**Model 1**		**Model 2**		**Model 1**		**Model 2**	
	β[a]	*p*	*β*	*p*	*β*	*p*	*β*	*p*	*β*	*p*	*β*	*p*
Block 1												
Baseline physical appearance satisfaction	0.373	0.000	0.396	0.000								
Dispositional positive affect					0.241	0.028	0.234	0.029				
Pre-intervention implicit self-esteem									0.452	<.001	0.456	<.001
Trait self-esteem	0.013	0.899	-0.018	0.861	-0.005	0.967	-0.022	0.847	-0.030	0.752	-0.036	0.707
Flexible mindset of physical appearance	0.098	0.253	0.083	0.318	0.048	0.631	0.036	0.697	-0.024	0.783	-0.027	0.752
Narcissism	0.186	0.047	0.225	0.015	0.057	0.574	0.088	0.375	0.005	0.954	0.018	0.853
Objective rating of physical appearance	-0.045	0.596	-0.005	0.950	-0.043	0.633	0.001	0.997	-0.133	0.119	-0.122	0.158
Block 2												
Perceived level of digital enhancement			0.244	0.004			0.221	.016			0.067	0.443
Model Summary	Δ*F*	*p*	Δ*F*	*p*	Δ*F*	*p*	Δ*F*	*p*	Δ*F*	*p*	Δ*F*	*p*
	6.341	0.000	8.538	0.004	1.895	0.100	6.003	0.016	6.032	<.001	0.593	0.443

Figure 1. Demonstration of the regular camera condition and beauty filter condition

Regular Camera Beauty filter

Figure 2. Summary of Study Procedures

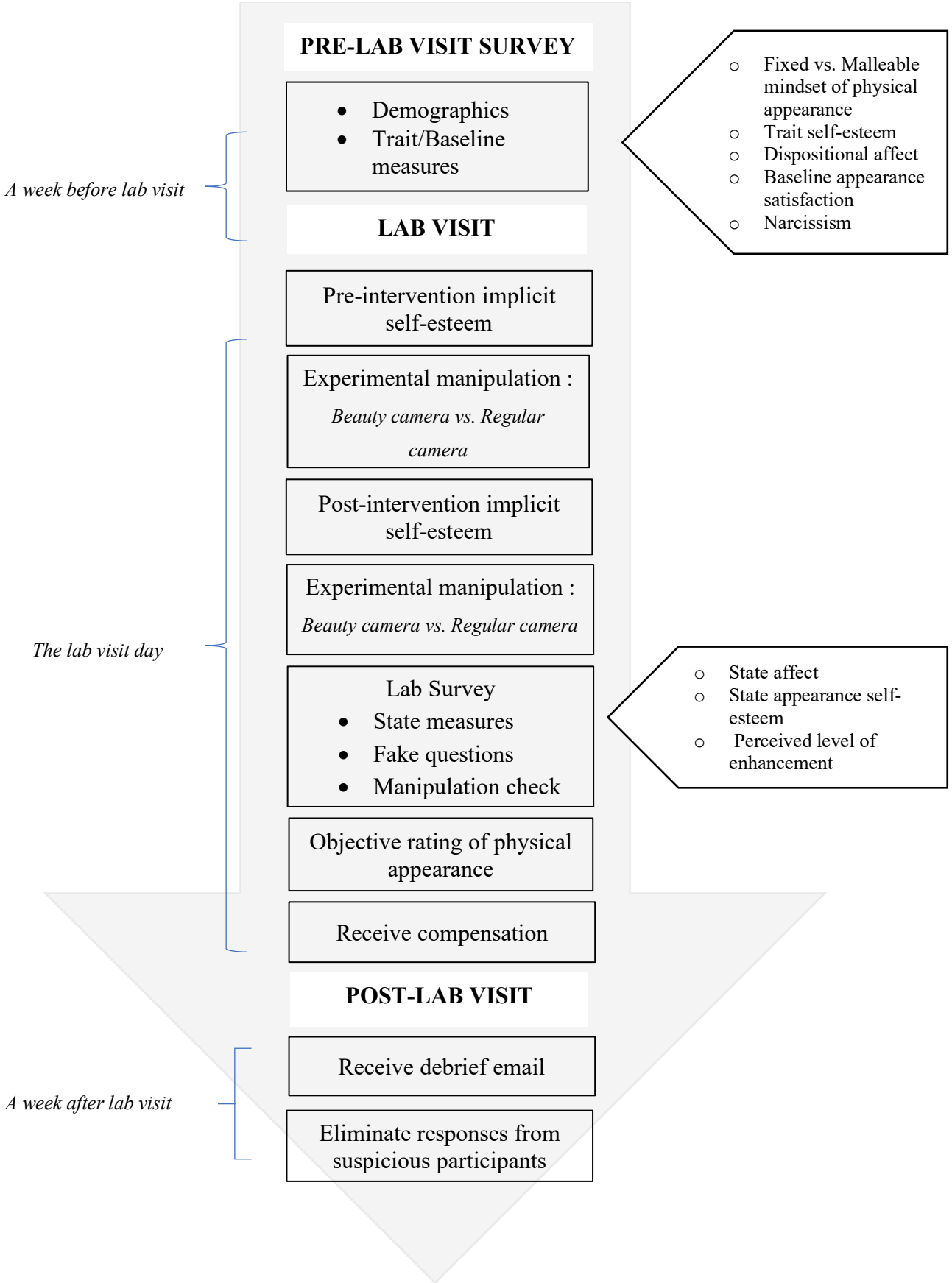
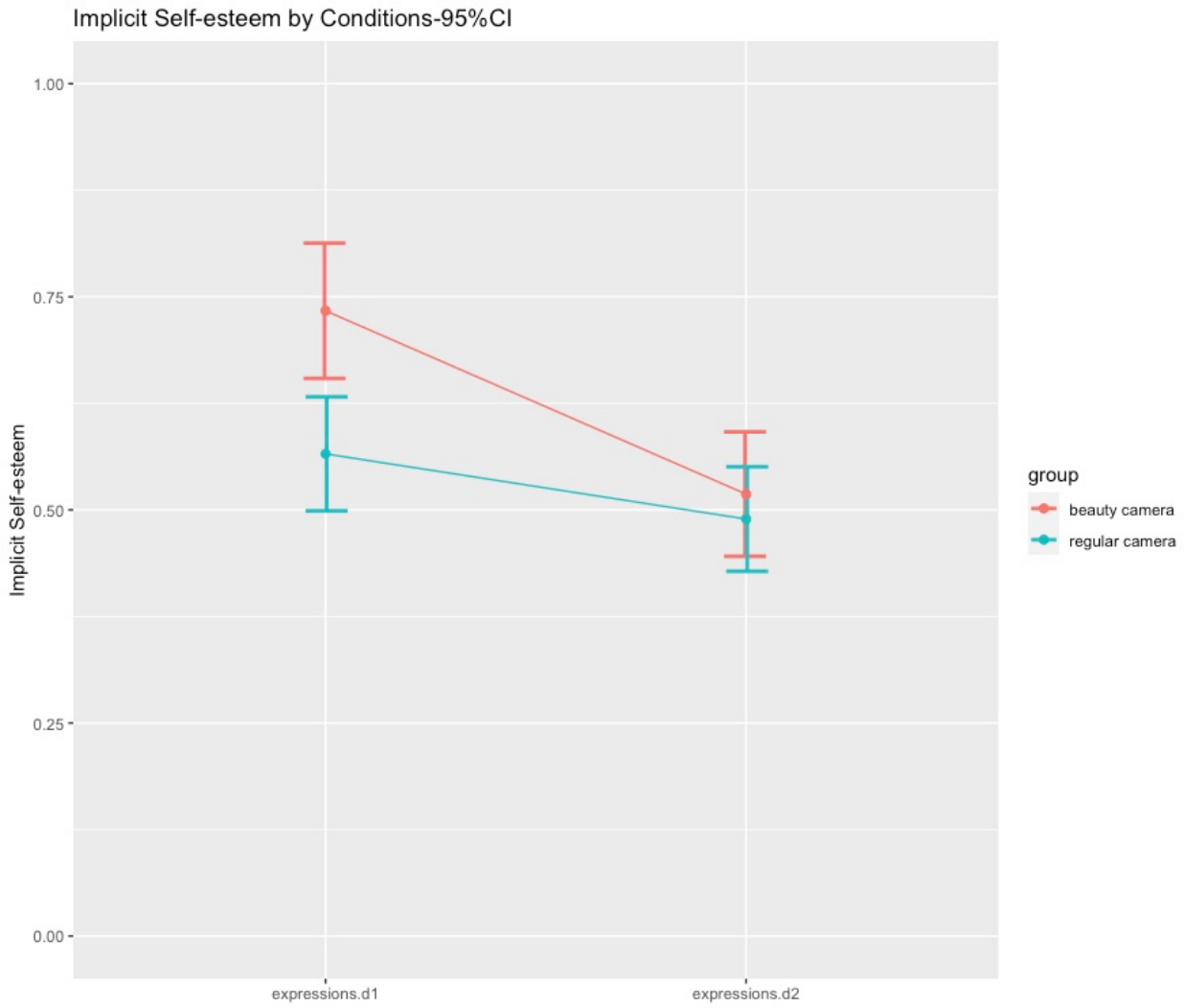


Figure 3. Mean changes in implicit self-esteem for both conditions from before to after the intervention



Appendix

Dependent Measures

State physical appearance self-esteem

How TRUE are the following statements to your feelings RIGHT NOW?

- I feel good about myself.
- I am pleased with my appearance.
- I feel unattractive (reverse)
- I feel satisfied with how my body look like. – deleted
- I feel others respect and admire me.
- I am dissatisfied with my weight right now (reverse) – deleted

1=not at all, 2= a little, 3=moderately, 4= quite a bit, 5= a lot

State positive affect

Below is a list of words to describe different feelings and emotions. Consider to what extent do you feel this way RIGHT NOW?

- Interested
- Excited
- Strong
- Enthusiastic
- Proud
- Alert
- Inspired
- Determined
- Attentive
- Active

1= not at all, 2=slightly, 3=moderately, 4=strongly, 5=extremely

Trait/Baseline Measures

Fixed vs. Malleable view of physical appearance

How much do you agree or disagree with the following statements?

- There is no ugly person but only persons who do not make efforts to look good.
- Natural beauty does not change much over a life time (reverse).
- One can improve how good he/she looks.
- To be honest, people who are born without natural beauty can't do much to change that.

1=strongly disagree, 2=disagree, 3=somewhat disagree, 4= somewhat agree, 5=agree, 6=strongly agree

Baseline appearance satisfaction

Do you agree or disagree with the following statements about you?

- I'm happy with the way I look
- I wish my height or weight was different
- I think I am physically attractive
- I like my body the way it is
- I am satisfied with my facial features
- I do not like my physical appearance.

1=strongly disagree, 2=disagree, 3=somewhat disagree, 4= somewhat agree, 5=agree, 6=strongly agree

Dispositional Positive Affect

Below is a list of words to describe different feelings and emotions. Consider to what extent you generally feel this way, that is, how you feel on average.

- Interested
- Excited
- Strong
- Enthusiastic
- Proud
- Alert
- Inspired
- Determined
- Attentive
- Active

1= not at all, 2=slightly, 3=moderately, 4=strongly, 5=extremely

Rosenberg's Self-esteem Scale

Please indicate the extent to which you agree with each of the following statements on a scale from 0 (strongly disagree) to 3 (strongly agree).

1. I feel that I am a person of worth, at least on an equal basis with others.
2. I feel that I have a number of good qualities.
3. All in all, I am inclined to feel that I am a failure.
4. I am able to do things as well as most other people.
5. I feel I do not have much to be proud of.
6. I take a positive attitude toward myself.
7. On the whole, I am satisfied with myself.
8. I wish I could have more respect for myself.
9. I certainly feel useless at times.
10. 10. At times I think I am no good at all.

Narcissism-NPI-16

Read each pair of statements (e.g., 1a & 1b) below and select the one that comes closest to describing your feelings and beliefs about yourself. You may feel that neither statement describes you well but pick the one that comes closest by checking the bubble next to the statement**.**

1a. I really like to be the center of attention.	☐	☐	1b. It makes me uncomfortable to be the center of attention.
2a. I am no better or no worse than most people.	☐	☐	2b. I think I am a special person.
3a. Everybody likes to hear my stories.	☐	☐	3b. Sometimes I tell good stories.
4a. I usually get the respect I deserve.	☐	☐	4b. I insist upon getting the respect that is due to me.
5a. I don't mind following orders.	☐	☐	5b. I like having authority over people.
6a. I am going to be a great person.	☐	☐	6b. I hope I am going to be successful.
7a. People sometimes believe what I tell them.	☐	☐	7b. I can make anybody believe anything I want them to.
8a. I expect a great deal from other people.	☐	☐	8b. I like to do things for other people.
9a. I like to be the center of attention.	☐	☐	9b. I prefer to blend in with the crowd.
10a. I am much like everybody else.	☐	☐	10b. I am an extraordinary person.
11a. I always know what I am doing.	☐	☐	11b. Sometimes I am not sure of what I am doing.
12a. I don't like it when I find myself manipulating people.	☐	☐	12b. I find it easy to manipulate people.

13a. Being an authority doesn't mean much to me.	☐	☐	13b. People always seem to recognize my authority.
14a. I know that I am good because everybody keeps telling me so.	☐	☐	14b. When people compliment me I sometimes get embarrassed.
15a. I try not to be a show off.	☐	☐	15b. I am apt to show off if I get the chance.
16a. I am more capable than other people.	☐	☐	16b. There is a lot that I can learn from other people.

Items with asterisk* are narcissistic responses. The rest are non-narcissist responses.

Fake questions in post-exposure survey

- How do you like the color tune of this camera app?

  1= very poor

  2= poor

  3= average

  4= good

  5= very good

- How do you like the clarity of this camera app?

  1= strongly dislike

  2= somewhat dislike

  3= neither like or dislike

  4= somewhat like

  5= strongly like

- Overall, how do you like the effect of the camera app?

  1= strongly dislike

  2= somewhat dislike

  3= neither like or dislike

  4= somewhat like

  5= strongly like

- If you have this app on your phone, how likely would you use it for taking selfies?

  1= very unlikely

  2= unlikely

  3= maybe

4= likely

5= very likely