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Nostalgia and Self-Enhancement: Phenotypic and Genetic Approaches

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Abstract:	We addressed phenotypic and genetic research questions regarding nostalgia and self-enhancement. At the phenotypic level (178 university students; Study 1), we found that nostalgia was moderately associated with self-enhancement. At the genotypic level (232 twin pairs; Study 2), we found that nostalgia, self-enhancement, and their relation were largely heritable. Our findings shed light on two heavily investigated traits and open up exciting research directions.

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Abstract

We addressed phenotypic and genetic research questions regarding nostalgia and self-enhancement. At the phenotypic level (178 university students; Study 1), we found that nostalgia was moderately associated with self-enhancement. At the genotypic level (232 twin pairs; Study 2), we found that nostalgia, self-enhancement, and their relation were largely heritable. Our findings shed light on two heavily investigated traits and open up exciting research directions.

Keywords: nostalgia, self-enhancement, better-than-average effect, behavioral genetics, twin study

In this article, we combined phenotypic and genetic approaches to investigate nostalgia, self-enhancement, and their association. We posed four questions. At the phenotypic level, we asked whether nostalgia is associated with self-enhancement. At the genotypic level, we inquired about the extent to which nostalgia is heritable, self-enhancement is heritable, and the association between nostalgia and self-enhancement is heritable.

Nostalgia and Self-Enhancement at the Phenotypic Level

Nostalgia "a sentimental longing or wistful affection for the past" (*The New Oxford Dictionary of English*, 1998, p. 1266), is a social and predominantly positive emotion. In nostalgic reverie, one brings to mind a fond and personally meaningful aspect of their past (e.g., childhood, close relationship, keepsake). The nostalgist often sees the past through rose-colored glasses, misses that time or relationship/object, and may wish for a momentary return to yesteryear. The nostalgist feels sentimental, most often happy but with a tinge of longing. Nostalgia is experienced frequently among adults of all ages as well as among teenagers and older children, and is felt by individuals across cultures in all continents (Hepper, Ritchie, Sedikides, & Wildschut, 2012; Hepper, Wildschut, et al., 2014; Hepper, Robertson, Wildschut, Sedikides, & Routledge, 2016; Wildschut, Sedikides, Arndt, & Routledge, 2006; Zhou, Sedikides, Wildschut, & Gao, 2008).

Crucially, nostalgia is a self-relevant emotion. The self is the protagonist of nostalgic narratives, albeit surrounded by close others. Nostalgic narratives usually involve a redemptive sequence (McAdams, Reynolds, Lewis, Patten, & Bowman, 2001), where the self overcomes adversity, emerging victorious (Wildschut et al., 2006). These redemptive sequences reflect momentous events from one's life—events that may be atypically positive and are personally or vicariously satisfying (Havlena & Holak, 1991; Morewedge, 2013). Indeed, momentarily induced nostalgia boosts state self-esteem (Reid, Green, Wildschut, & Sedikides, 2015; Wildschut et al., 2006), strengthens the accessibility of positive self-attributes (Vess, Arndt, Routledge, Sedikides, & Wildschut, 2012), and colors favorably perceptions of the future (i.e.,

optimism, psychological growth; Baldwin & Landau, 2014; Cheung et al., 2013). In short, nostalgizing paints a more positive present and future self. However, this conclusion needs to be qualified, as it pertains to state-level (i.e., momentary) processes. Given that nostalgia can also manifest as a trait (i.e., proneness to nostalgic engagement), an important question is whether trait-level nostalgia is related to self-enhancement. We addressed this question in our research.

We defined self-enhancement in terms of the desire to maximize the positivity of one's self-views (Alicke & Sedikides, 2009; Sedikides & Gregg, 2008). This desire is manifested, in part, with the better-than-average-effect (BTAE; Alicke, 1985; Guenther & Alicke, 2010), the phenomenon of rating oneself above the average peer standing on desirable characteristics. The BTAE is robust and observable across cultures (Sedikides & Alicke, 2012; Sedikides, Gaertner, & Cai, 2015). We asked, for the first time, whether the dispositional tendencies toward nostalgic reverie and self-enhancement covary. There are three reasons they might. First, as we described above, nostalgia momentarily increases the positivity of the present and future selves. Second nostalgia is linked to positive, self-related outcomes: The more nostalgic participants are, the more likely they are to be high on approach motivation (Stephan et al., 2014, Study 1), and also to report greater inspiration (Stephan et al., 2015, Study 1), meaning in life (Routledge et al., 2011, Study 1), and intrinsic self-expression (Baldwin, Biernat, & Landau, 2015, Study 7). Finally, evidence links state and trait levels: Density distributions of states may be considered traits (Fleeson, 2001). By implication, covarying density distributions of two states may be considered covarying traits. Thus, strong covariation of state nostalgia and self-positivity would suggest covariation of trait nostalgia and self-enhancement. Based on this rationale, we hypothesized that trait nostalgia and trait self-enhancement are positively related (H1). We tested this hypothesis in a sample of Chinese university students (Study 1).

Nostalgia and Self-Enhancement at the Genotypic Level

We assessed, for the first time, the heritability of nostalgia, self-enhancement, and their association in a sample of Chinese twins (Study 2). We wondered about the

extent to which nostalgia is heritable. As a trait, nostalgia is prevalent (Hepper et al., 2014, 2016; Wildschut et al., 2006; Zhou et al., 2008) and varies substantially across persons (Juhl, Routledge, Arndt, Sedikides, & Wildschut, 2010; Routledge, Arndt, Sedikides, & Wildschut, 2008; Sedikides, Wildschut, et al., 2015). These individual differences are likely to arise from various environmental and genetic sources (Johnson, Penke, & Spinath, 2011). Indeed, nostalgia proneness is moderately correlated with right-frontal cortical asymmetry as assessed with electroencephalography (EEG; Tullett, Wildschut, Sedikides, & Inzlicht, 2015) indicating that trait nostalgia is not completely shaped by environment and instead has innate sources. Therefore, we hypothesized that genetic factors are likely to explain part of the variance in individual differences in nostalgia (H2).

We also wondered about the extent to which self-enhancement is heritable. Although the possibility of genetic effects on the BTAE per se has largely gone unexplored, numerous studies have demonstrated substantial genetic contribution to variation in self-regard, including self-esteem, narcissism, and name-liking (Luo, Cai, Sedikides, & Song, 2014; Luo, Shi, Cai, Wu, & Song, 2014; Neiss, Sedikides, & Stevenson, 2002, 2006; Vernon, Villani, Vickers, & Harris, 2008). These findings suggest that the related construct of BTAE may also be genetically influenced. Indeed, the magnitude of BTAE is negatively related to orbitofrontal cortex (OFC) and dorsal anterior cingulate cortex (dACC) activation (Beer & Hughes, 2010). Therefore, we hypothesized that individual differences in self-enhancement would also be partly attributable to genetic influences (H3).

We hypothesized a positive association between nostalgia and self-enhancement at the phenotypic level (H1). We sought to extend this hypothesis by identifying genetic and environmental bases of the covariation between nostalgia and self-enhancement—an initial step in understanding underlying causal processes. Although our investigation represents a foray into the genetic relation between self-enhancement and nostalgia, similar efforts have targeted other aspects of self-regard and emotionality, such as self-esteem and optimism (Caprara et al., 2009). Genetic

influences explained the majority of overlap between self-esteem and optimism, with environmental influences being primarily unique to each. These findings are relevant to our investigation, given that nostalgia is linked with optimism (Cheung et al., 2013; Cheung, Sedikides, & Wildschut, 2016), while self-esteem and the BTAE are closely related (Brown, 1986; Sedikides & Alicke, 2012). Another line of evidence also forms the basis for our investigation. Both nostalgia (Stephan et al., 2014; Zhou, Wildschut, Sedikides, Shi, & Feng, 2012) and self-enhancement (Alicke & Sedikides, 2009; Sedikides, Gaertner, & Cai, 2015) are associated with approach motivation, which is heritable (Takahashi et al., 2007). Thus, genetic influences on approach motivation may also pertain to nostalgia and self-enhancement, resulting in a genetic connection between the two. Given these clues and the putative heritability of nostalgia (H2) and self-enhancement (H3), we proceeded to hypothesize that the association between nostalgia and self-enhancement will be due, in part, to shared genetic factors (H4).

Study 1

In Study 1, we assessed the covariation between nostalgia proneness and self-enhancement in a student sample, testing H1.

Method

Participants. We recruited 178 persons from the participant pool of the Institute of Psychology, Chinese Academy of Sciences (gender: 98 females, 80 males; age: *Range* = 18-29, *M* = 21.63, *SD* = 2.29). This participant pool includes students from Beijing-based universities. We set the time limit for data collection as three months (October, 2014–December, 2014) and tested all students available during that interval. We did so under the stipulation that the final sample size exceed 150 in order to achieve at least 80% power for detecting a small-to-medium effect (r = .20; Cohen, 1988).

Measures. Participants completed measures of nostalgia and self-enhancement (along with several unrelated ones) in private rooms. Measures were translated into Chinese, and then back-translated, by a committee of bilinguals (Brislin, 1980).

***Nostalgia*.** We assessed nostalgia with the Southampton Nostalgia Scale (SNS;

Barrett et al., 2010; Sedikides, Wildschut, et al., 2015). The SNS consists of seven items that gauge proclivity to nostalgia (e.g., "How prone are you to feeling nostalgic?"), frequency of nostalgia (e.g., "How often do you experience nostalgia?"), and personal relevance ("How important is it for you to bring to mind nostalgic experiences?"). Participants responded to these questions on a 7-point scale (1 = *not at all*, 7 = *very much*). We averaged across items to form a nostalgia index (α = .88; *M* = 4.80, *SD* = 1.06). The SNS has been validated in Chinese samples (Zhou et al., 2008; Zhou, Wildschut, Sedikides, Chen, & Vingerhoets, 2012).

Self-enhancement. We operationalized self-enhancement with the BTAE, which we measured with a modified version of the better-than-average (BTA) task (Alicke, 1985). Participants rated themselves in relation to the average person of the same gender and age on 16 traits (1 = *much less than the average person*, 6 = *much more than the average person*). The traits were: attractive, capable, considerate, cooperative, creative, easy-going, friendly, gifted, independent, kind, loyal, polite, self-reliant, sincere, smart, unique. We averaged these ratings into an aggregate score (α = .89; *M* = 4.22, *SD* = 0.50).

Results and Discussion

Responses to the SNS and BTA task were moderately related, $r(176) = .199$, $p = .008$. However, because we assessed both nostalgia and self-enhancement with self-report measures, it is possible that common method variance (CMV) inflated this correlation. For brevity and ease of exposition, we addressed this issue with the partial correlation approach developed by Lindell and Whitney (2001). A more elaborate confirmatory factor analysis procedure (Williams, Hartman, & Cavazotte, 2010) produced identical conclusions (online supplementary material S2). The partial correlation approach relies on identifying a marker variable that is theoretically unrelated to the substantive variables (nostalgia, self-enhancement) but is assessed with the same method. If the theoretical correlation between the marker variable and the substantive variables is 0, then unexpected nonzero correlations indicate CMV. The marker variable was belief in a just world (BJW; Dalbert, 1999). We selected the

smallest observed correlation between marker and substantive variables to estimate CMV (r_{BJWSNS} = .025, p = .739). We then calculated the partial correlation between SNS and BTA task, adjusting for CMV (Lindell & Whitney, p. 116, Equations 4-5). This resulted in a minor diminution of the significant relation between nostalgia and self-enhancement, $r(175)$ = .178, p = .017.

The more nostalgic participants were, the more likely they were to self-enhance. The results were consistent with H1, even after controlling for CMV. Furthermore, a supplementary study replicated the relation between nostalgia and self-enhancement in a Western sample.[1]

Study 2

In Study 2, we examined the extent to which nostalgia, self-enhancement, and their association are heritable (H2, H3, H4)

Method

Participants. We included measures of nostalgia and self-enhancement in the second testing wave of a longitudinal twin study, the Beijing Twin Study (BeTwiSt). Twins in the BeTwiSt are socio-demographically representative of their Beijing peers (Chen et al., 2013). A total of 232 twin pairs agreed to participate in the second testing wave (gender: 265 females, 199 males; age: *Range* = 17-25, *M* = 20.26, *SD* = 1.86). Of pairs, 117 were monozygotic (MZ), 115 dizygotic (DZ; 68 same-sex, 47 opposite-sex). For 95% of the twin pairs, zygosity was assigned by DNA testing, with classification accuracy approximating 100%; for the remaining pairs, zygosity was determined by a combination of parent-reports and children's self-reports about co-twin physical similarities and frequency of confusion, with a predictive accuracy of 90.6% (Chen et al., 2013).

Measures. We assessed the relevant constructs with the same measures as in Study 1. Both the SNS (α = .87; *M* = 4.53, *SD* = 1.18) and BTA task (α = .86; *M* = 4.38, *SD* = .48) had good reliability. Participants completed these measures (along with several unrelated ones) privately.

Genetic analyses. By comparing the resemblance of MZ and DZ twin pairs on

observed trait(s), we can estimate additive genetic (A), shared environmental (C), and non-shared environmental (E) contributions to (1) variance within a trait and (2) covariance between traits (Plomin, DeFries, McCleann, & McGuffin, 2008). MZ twins are 100% genetically identical, whereas DZ twins are on average 50% identical for additive genetic effects. In the usual case where twins are reared together, greater resemblance between MZ twins than between DZ twins indicates that the trait is heritable. Heritability denotes the proportion of the variance of a trait, or the covariance between traits, explained by additive genetic effects. A shared environment contributes to the similarity of twins growing up in the same family. A non-shared environment is unique to each individual (this component also includes measurement error).

To estimate the heritability of a single trait, we relied on univariate models implemented in the OpenMx package (Boker et al., 2012) for R. The variances of the SNS and BTA task were respectively partitioned into genetic (A) and environmental (C & E) effects.[2] We examined the full ACE model first, and then tested sub-models (AE, CE, and E models) nested within the full model by removing systematically one or two component(s) of variance. Next, the bivariate analysis of the SNS and BTA task utilized a correlated factors model based on the Cholesky decomposition (Loehlin, 1996). In this model, each variable is separately decomposed into its genetic, shared, and non-shared environmental components at the same time that the correlations across these variables are estimated (Figure 1.a). The genetic, shared environmental, and non-shared environmental correlations index the extent to which genetic, shared environmental, and non-shared environmental influences on the SNS and BTA task overlap, respectively. Based on the three correlations and the correlated factors model (Figure 1.a), we can further estimate how much genes, shared, and non-shared environments contribute to the phenotypic correlation between SNS and BTA task, respectively. Similar to the univariate analysis, we tested systematically the full ACE model and the sub-models.

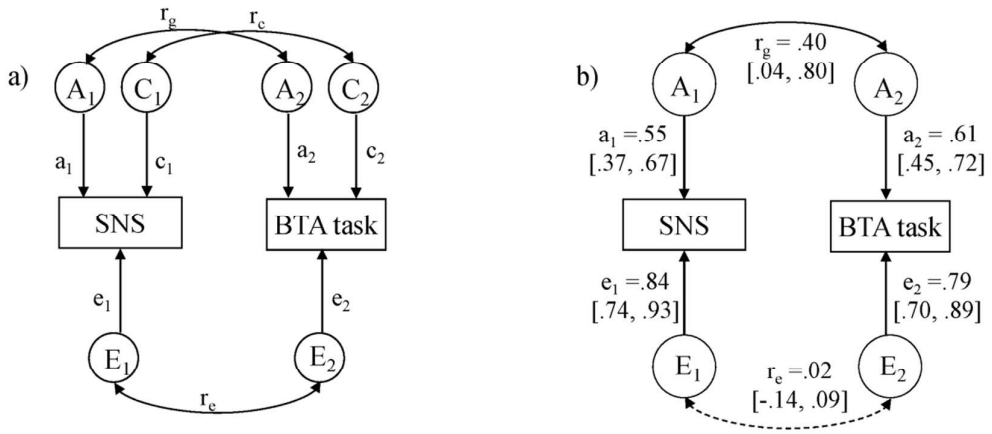

Figure 1. Bivariate model-fitting for nostalgia (SNS) and self-enhancement (BTA task) in Study 2. (a) Path diagram illustrating the bivariate model-fitting. (b) The best-fitting bivariate model. Measured variables are depicted in rectangles. Latent factors A (additive genetic factor), C (shared environmental factor), and E (non-shared environmental factor) are presented in circles. r_g = genetic correlation; r_c = shared environmental correlation; r_e = non-shared environmental correlation. All path estimates (95% confidence intervals), standardized but unsquared, are obtained from the best-fitting model. The non-significant path is represented by a dashed line.

We used the change in chi-square (χ^2) and the Akaike Information Criterion (AIC; Akaike, 1987) as model fit indices. A lower AIC value indicated better fit. Comparing the full model and a sub-model, a significant chi-square difference suggested that the nested model fits significantly worse than the full model, and thus the full model should be chosen; otherwise, the nested model with fewer parameters should be considered in terms of the parsimony principle (Bollen, 1989; Kline, 1998).

Results and Discussion

Descriptive statistics. First, we examined whether the positive association between nostalgia and self-enhancement is observed in a twin sample. It is. Responses to the SNS and BTA task were moderately related, $r(230) = .203$, $p = .002$. Adjusting for CMV (Lindell & Whitney, 2001) resulted in a modest diminution of the significant relation between nostalgia and self-enhancement, $r(229) = .161$, $p = .013$ (online supplement S2). H1 received additional support.

Twins are perfectly correlated for age, and same-sex twins are perfectly correlated for gender. As such, the variation associated with age or gender would inflate the correlation between twins. To address this potential confounding, we used

multiple regression analyses. On both SNS (β = -.09, p = .050) and BTA task (β = -.15, p = .001), females scored slightly lower than males. Age was not predictive of either SNS (β = -.007, p = .879) or BTA task (β = .08, p = .084). Nevertheless, following standard practice, we corrected all measures for age and gender effects using regression, and saved the standardized residuals for genetic analyses (McGue & Bouchard, 1984). For each measure, we excluded participants whose scores were 3 SDs beyond the mean values of the entire sample; thus, we excluded one MZ twin sibling and three DZ twin siblings on the BTA task (Table 1). In model fitting, we used all available data to increase statistical power, even if the data from one of the twins in a pair were excluded.

Table 1. Twin Intraclass Correlations (ICC) in Study 2

Measure	ICC_{MZ}	N_{MZ}	ICC_{DZ}	N_{DZ}
SNS	.46 (.22 - .62)	117	.29 (-.02 - .51)	115
BTA task	.55 (.35 - .69)	116	.18 (-.20 - .43)	112

Note. MZ = monozygotic twins; DZ = dizygotic twins; 95% confidence intervals of ICC are in parentheses.

Univariate genetic analysis. MZ twins resembled each other more than DZ twins did on the SNS (Table 1), suggesting that nostalgia is heritable. We proceeded to examine the heritability of nostalgia by fitting a series of univariate models (Table 2). The full ACE model identified 29% of individual differences in nostalgia as due to genetic influences. A further 70% was attributed to non-shared environmental influences, with only 1% contribution from shared environments. Hence, the AE model (excluding C) fit the data equally well as the full model. In comparison to the ACE model, the CE model (excluding A) also fit the data well, but the E model (excluding A and C) fit significantly worse. The AE model, however, displayed the lowest AIC value among the full model as well as all sub-models, and hence was chosen (Bollen, 1989; Kline, 1998). Estimates of the AE model were almost the same as those from the full ACE model. These results showed that genetic factors explained

part of the individual differences in nostalgia, thus supporting H2.

In regards to self-enhancement, MZ twins resembled each other more than DZ twins did (Table 1), suggesting significant genetic influences. A series of univariate model-fitting supported this result (Table 2). The full ACE model identified a genetic effect of 37% and a non-shared environmental effect of 63%, without any significant contributions from shared environment. Dropping C (AE model) did not change model fit. However, excluding A (CE model) or both A and C (E model) reduced model fit significantly. Hence, we deemed the AE model preferable (Bollen, 1989; Kline, 1998). In the AE model, the estimates for the genetic and non-shared environmental influences were the same as those in the full model. H3 was supported: genetic effects accounted, in part, for the variance in the BTA task. Due to the moderate sample size, confidence intervals of the genetic and non-shared environmental estimates were relatively large for both SNS and BTA task.

Table 2. Univariate Genetic Model-Fitting

					Change from full model					
Measure	Model	-2LL	*df*	AIC	$\Delta\chi^2$	Δdf	*p*	a^2	c^2	e^2
SNS	ACE	1301.63	460	381.63				.29 (.00–.45)	.01 (.00–.31)	.70 (.56–.89)
	AE	1301.63	461	379.63	0.00	1	1.000	.30 (.14–.45)		.70 (.56–.86)
	CE	1303.06	461	381.06	1.42	1	.233		.22 (.09–.33)	.79 (.67–.91)
	E	1313.99	462	389.99	12.36	2	.002			1.00 (1.00–1.00)
BTA task	ACE	1242.02	456	330.02				.37 (.09 -.51)	.00 (.00 -.20)	.63 (.49 -.80)
	AE	1242.02	457	328.02	0.00	1	1.000	.37 (.20 -.51)		.63 (.49 -.80)
	CE	1247.63	457	333.63	5.62	1	.018		.23 (.10 -.35)	.77 (.65 -.90)
	E	1259.51	458	343.51	17.49	2	.000			1.00 (1.00 - 1.00)

Note. -2LL = twice the negative log-likelihood, the difference between -2LL of two models is subjected to chi-square (χ^2) distribution. Two fit indices are reported: change in chi-square ($\Delta\chi^2$) and Akaike's Information Criterion (AIC). Δdf = change in degrees of freedom (*df*). a^2, c^2, and e^2 are proportion of variance due to additive genetic (A), shared environmental (C), and non-shared environmental effect (E). 95% confidence intervals are in parentheses. E, CE, and AE models are nested within ACE. The best-fit model is underlined.

Bivariate genetic analysis. We used the correlated factors model to examine the overlap between genetic as well as environmental influences on nostalgia and self-enhancement (Figure 1.a). We tested the full ACE model first and thereafter the AE, CE, and E models (Table 3). Compared to the full model, the AE model fit the data equally well. However, the CE and E models worsened model fit. Thus, like the univariate model-fitting, the AE model was optimal (Figure 1.b). The AE model identified a significant genetic correlation (.40), but a non-significant non-shared environmental correlation (.02), between nostalgia (SNS) and self-enhancement (BTA task). Based on the two correlations, the phenotypic correlation between SNS and BTA task was predominantly (90%, 95% CI: .11 – 1.00) due to genetic influences. The non-shared environmental influences were non-significant (95% CI: -1.00 - .89). This indicated that nostalgia and self-enhancement share some common genetic sources, which provide the basis for their phenotypic relation, but their non-shared environment bases are different. Hence, the finding supported H4 by identifying a genetic link between the two traits. We acknowledge that confidence intervals were relatively large due to the moderate sample size.

Table 3. Bivariate Genetic Model-Fitting

				Change from full model		
Model	-2LL	*df*	AIC	$\Delta\chi^2$	Δdf	*p*
ACE	2533.45	913	707.45			
AE	2533.45	916	701.45	0.01	3	1.000
CE	2540.74	916	708.74	7.30	3	.063
E	2563.79	919	725.79	30.35	6	.000

Note. -2LL = twice the negative log-likelihood; AIC = Akaike's Information Criterion; $\Delta\chi^2$ = change in chi-square; Δdf = change in degrees of freedom (df); A = additive genetic effects; C = shared environmental effects; E = non-shared environmental effects. E, CE, and AE models are nested within the ACE model. The best fitting model is underlined.

General Discussion

We pioneered an investigation into phenotypic and genotypic relations between nostalgia and self-enhancement. Our findings are novel and generative. First, we obtained a positive association between nostalgia and self-enhancement in samples of university students, precollege students, and twins. Although the literature has hinted to that (e.g., nostalgia-prone individuals report more inspiration and intrinsic self-expression; Baldwin et al., 2015, Study 7; Stephan et al., 2015, Study 1), no link between dispositional nostalgia and self-enhancement had been identified before. The link we found is compatible with experimental evidence that state-level nostalgia strengthens the accessibility of positive self-attributes (Vess et al., 2012, Experiment 1), raises self-esteem (Hepper et al., 2012, Study 7; Wildschut et al., 2006, Study 5), and increases growth-oriented perceptions (e.g., self-expansion, authenticity: Baldwin & Landau, 2014; Stephan, Sedikides, & Wildschut, 2012, Study 2), optimism (Cheung et al., 2013, Studies 2-4), as well as inspiration (Stephan et al., 2015, Studies 2-6; for a review, see Sedikides & Wildschut, 2016a). Moreover, this link highlights that nostalgia can be a relatively stable predictor of self-enhancement, in addition to an immediate inducer. That is, people high on nostalgia proneness are more likely to harvest the benefits of nostalgic reverie, one of which is sustaining positive self-views. Taken together, nostalgia has both temporary and lasting psychological advantages (for reviews see: Sedikides & Wildschut, 2016b; Sedikides, Wildschut, et al., 2015). Yet, our finding will need to be assessed both cross-culturally and longitudinally. Does nostalgia confer self-enhancement in the long run? Is nostalgia-induced self-enhancement associated with psychological health indicators (e.g., lower depression or anxiety)?

Second, we documented the heritability of nostalgia. A literature has established that nostalgia buffers against various types of self-threat, such as social threat, performance-related threat, or existential threat (Routledge, Wildschut, Sedikides, & Juhl, 2013; Sedikides, Wildschut, Arndt, & Routledge, 2008; Sedikides, Wildschut, et al., 2015). Further, whether an individual frequently resorts to nostalgia to buffer

against self-threat may be partially shaped by the environment, such as pleasant emotional and behavioral childhood experiences (Sedikides, Wildschut, et al., 2015). This is not the whole story, however. Our research, for the first time, showed that nostalgia proneness is also genetically based. That is, 29% of individual differences in nostalgia are attributable to genetic factors, with a further 70% attributable to non-shared environments, and only 1% attributable to shared environments. Hence, although environments play a key role in nostalgia, whether people will become nostalgists is partially due to intrinsic mechanisms. Forays into the interplay between neural processing and genetic factors would be promising, in light of a recently reported association between nostalgia proneness and baseline levels of right-frontal cortical asymmetry (assessed with EEG; Tullett et al., 2015).

Third, we established the heritability of self-enhancement. An emerging literature indicates that self-regard (including self-esteem, name-liking, and narcissism) is heritable (Luo, Cai, et al., 2014; Luo, Shi, et al., 2014; Neiss et al., 2002, 2006; Vernon et al., 2008). Our finding on the heritability of the BTAE complemented this literature. Given the positive relations among self-esteem, narcissism, and the BTAE (Alicke & Sedikides, 2009; Sedikides & Gregg, 2008), it is possible that a common core (i.e., a core self-enhancing orientation) underlies them. Moreover, in light of the heritability of various manifestations of self-enhancement, the core self-enhancing orientation is likely to be heritable. This topic warrants multivariate behavioral genetic investigations. Another hopeful research direction concerns the relation between genotype and endophenotype, as the BTAE is negatively related to orbitofrontal cortex (OFC) and dorsal anterior cingulate cortex (dACC) activation (Beer & Hughes, 2010). It is possible that genetic factors influence the BTAE and other self-enhancement indicators via neural mechanisms (Cai, Wu, Shi, Gu, & Sedikides, in press). Nonetheless, our results, in conjunction with previous findings on the heritability of self-esteem and narcissism (Luo, Cai, et al., 2014; Luo, Shi, et al., 2014; Neiss et al., 2002, 2006; Vernon et al., 2008), indicate that non-shared environments make a large contribution (40%~72%) to individual differences

in self-enhancement. Therefore, non-shared environments (e.g., parenting, schooling) are also crucial in that respect.

Finally, and more importantly, we verified the heritability of the association between nostalgia and self-enhancement. The pattern of genetic or environmental covariation between nostalgia and self-enhancement can provide clues to common versus distinct etiology. The substantial genetic correlation (.40) between nostalgia proneness (SNS) and self-enhancement (the BTAE, as indexed by the BTA task) indicates that their association had a genetic basis. Indeed, this genetic correlation accounted for most (90%) of the phenotypic association between nostalgia and self-enhancement, testifying to the fundamental nature of the link. The considerable genetic relation between nostalgia and self-enhancement not only corroborates the self-enhancing function of nostalgia, but also suggests a common core underlying nostalgia and self-enhancement. This core likely lies in approach motivation: Both nostalgia (Stephan et al., 2014; Zhou, Wildschut, Sedikides, Shi, et al., 2012) and self-enhancement (Alicke & Sedikides, 2009; Sedikides, Gaertner, & Cai, 2015) are linked with approach-oriented tendencies, and approach motivation is heritable (Takahashi et al., 2007). It is possible that genetic factors underlying approach motivation are involved in the relatively close genetic connection between nostalgia and self-enhancement. This issue will need to be addressed in twin studies that assess simultaneously nostalgia, self-enhancement, and approach motivation. In addition, the dominance of genes in the relation between nostalgia and self-enhancement concurs with the major role of genes in the association between self-esteem and optimism (Caprara et al., 2009). Together, these associations imply that, although the self and emotionality are primarily driven by environments, their connection is largely genetic. This intrinsic link calls for further research into underlying mechanisms, which may improve our understanding of emotional well-being.

Nonetheless, our findings should be interpreted with limitations in mind. All of our measures were based on self-report. This shared method may inflate the correlation between nostalgia and self-enhancement. Reassuringly, such inflation did

not occur in our data, as we verified via partial correlation (Lindell & Whitney, 2001) and confirmatory factor analysis (Williams et al., 2010; online supplement S2) techniques. However, replications with behavioral measures or informant-reports of nostalgia and self-enhancement are warranted. Furthermore, we adopted the classic ACE model in genetic analyses, which overlooks the possibility that genetic and environmental influences on individual differences may correlate or interact with each other (Purcell, 2002). For example, genes may predispose individuals to select or create environments in which they are more (vs. less) frequently exposed to nostalgic cues (e.g., decorating their home with nostalgic mementos)—a gene-environment correlation. Genes may also render individuals more (vs. less) sensitive to nostalgic cues in their environment—a Gene x Environment interaction. These potential correlations and interactions between genes and environments warrant future investigations. Finally, although our twin sample consisted of 463 participants, this constitutes a moderate sample. Such as sample size contributed to relatively wide confidence intervals and limited the statistical power to test the equivalence of shared environments across zygosity and to identify significant shared environmental influences, the potential moderating role of sex, and possible interactions/correlations between genes and environments. Future studies will need to use larger samples.

In conclusion, we found, in diverse samples, that nostalgia and self-enhancement are phenotypically associated. We also found, in a twin sample, that nostalgia and self-enhancement are heritable, and that their association is substantially genetically based, with non-shared environments accounting for the remaining variation. The results establish the genetic underpinning of two key variables in the personality and self literatures, while pointing to exiting empirical directions.

Footnotes

1. Following the logic of convergent operations (Campbell & Fiske, 1959), we conducted a supplementary study to test (1) if nostalgia proneness is related to another index of self-enhancement (in addition to the BTAE) and (2) if another measure of nostalgia proneness (in addition to the SNS) is related to self-enhancement. We provide a detailed description of this study in S1, available online as supplementary material. Participants were 93 sixth-form (i.e., preparatory college) students from Hampshire, England. We assessed nostalgia proneness with two measures: the SNS (see Study 1) and the Past-Positive subscale of Zimbardo and Boyd's (1999) Time Perspective Inventory. These two nostalgia scales were strongly correlated, attesting to their convergent validity, $r(93) = .61$, $p < .001$. We again operationalized self-enhancement with a modified version of the BTA task. As an additional measure of self-enhancement, we administered the Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965). Consistent with the notion that they are both indicators of self-enhancement (Alicke & Sedikides, 2009; Sedikides & Gregg, 2008) and prior research documenting their robust association (Brown, 1986; Sedikides & Alicke, 2012; Taylor, Lerner, Sherman, Sage, & McDowell, 2003), the BTA task and RSES ratings were highly correlated, $r(93) = .61$, $p < .001$. Importantly, both nostalgia scales were positively correlated with both indicators of self-enhancement. SNS scores were moderately correlated with the BTA task ($r[93] = .31$, $p = .003$) and RSES ($r[93] = .27$, $p = .008$). Likewise, Past-Positive scores were moderately correlated with the BTA task ($r[93] = .34$, $p < .001$) and RSES ($r[93] = .48$, $p < .001$). All associations remained significant after controlling for extraversion, neuroticism, and interdependent self-construal. These results support the generality of the association between nostalgia and self-enhancement.
2. Although MZ correlations were more than twice as large as DZ correlations for the BTAE, we did not estimate non-additive genetic effect (ADE model), because our relatively small sample lacks adequate power (Martin, Eaves, Kearsey, & Davies, 1978). As for the DE model, we did not test it, because a model with dominant

genetic variance that lacks additive genetic variance is biologically implausible (Neale & Cardon, 1992).

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S1

Additional Study

We conducted a supplementary study to test (1) if nostalgia proneness is related to another index of self-enhancement (in addition to the BTAE) and (2) if another measure of nostalgia proneness (in addition to the SNS) is related to self-enhancement. We selected the Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965) as additional measure of self-enhancement (Brown, 1986; Alicke & Sedikides, 2009; Sedikides & Alicke, 2012; Sedikides & Gregg, 2008). We selected the Past-Positive subscale of Zimbardo and Boyd's (1999) Time Perspective Inventory (TPI-PP) as additional measure of nostalgia proneness. In prior research, the SNS and TPI-PP were positively correlated, attesting to their convergent validity (Routledge, Arndt, Sedikides, & Wildschut, 2008).

In addition, we assessed three control variables that overlap with both nostalgia and self-enhancement. By so doing, we seek to reduce specification error. Specification error arises when nostalgia and self-enhancement share a common cause, which has not been included in the model (i.e., the third-variable problem). Specification error could lead to identification error (i.e., misestimation of the relation between nostalgia and self-enhancement; Cohen & Cohen, 1983). Nostalgia is positively correlated (albeit weakly) with two domain-level personality variables: extraversion and neuroticism (Stephan et al., 2015). In turn, extraversion (positively) and neuroticism (negatively) are associated with self-enhancement (Davies, French, & Keogh, 1998; Stöber, Dette, & Musch, 2002). Accordingly, we administered the Extraversion and Neuroticism subscales of the Big Five Inventory (BFI; John, Donahue, & Kentle, 1991). We also assessed relational-interdependent self-construal or the general tendency to think of oneself in terms of close relationships. Previous studies indicated that nostalgia-prone individuals have a preference for activities with other people (Batcho, 1998) and a strong need to belong (Seehusen et al., 2013). In turn, relational-interdependent self-construal has been linked with increased self-enhancement, in particular on communal traits/collectivistic attributes (e.g., "I am a better than average listener"; Kurman, 2001; Sedikides, Gaertner, & Toguchi, 2003). We used the Relational-Interdependent Self-Construal Scale (RISC; Cross, Bacon, & Morris, 2000).

Method

Participants. Participants were 93 sixth-form (i.e., preparatory college) students from Hampshire, England (64 females; M_{age} = 16.83, SD_{age} = 0.56, range = 16-19 years). They completed the study as a classroom activity.

Procedure and measures. We administered two measures of nostalgia proneness: the SNS (see Study 1; α = .91, *M* = 4.10, *SD* = 1.27) and the TPI-PP (e.g., "I get nostalgic about my childhood"; 1 = *very uncharacteristic of me,* 5 = *very characteristic of me*; α = .82, *M* = 3.58, *SD* = 0.74). These two nostalgia scales were strongly positively correlated, corroborating their convergent validity, $r(93) = .61$, $p < .001$. To assess the control variables (extraversion, neuroticism, and interdependent self-construal), we administered the Extraversion (e.g., "I see myself as someone who is outgoing, sociable"; 1= *disagree strongly*, 5 = *agree strongly*; α = .87, *M* = 3.60, *SD* = 0.77) and Neuroticism (e.g., "I see myself as someone who worries a lot"; 1 = *disagree strongly*, 5 = *agree strongly*; α = .81, *M* = 3.01, *SD* = 0.77) subscales of the BFI (John et al., 1991), and the RISC (e.g., "My close relationships are an important reflection of who I am"; 1 = *does not describe me well,* 7 = *describes me well*; α = .80, *M* = 5.12, *SD* = 0.82; Cross et al., 2000). Next, we instructed participants to recall and write about an autobiographical experience (3-4 min). We introduced this recall task, because individuals are sensitive to situational cues that encourage expression of trait-relevant thoughts, feelings, and behaviors. For example, individuals who are high in extraversion exhibit more extraverted behaviors at certain time of the day and when the number of surrounding others increases (Fleeson, 2001). By cueing autobiographical memory, we thus aimed to create an optimal context for testing the relation between nostalgia proneness and self-enhancement. Following this brief recall task, we assessed self-enhancement with a modified version of the BTA task, as in Study 1. We presented participants with 14 attributes and instructed them to rate themselves in comparison to the average student of their age and gender ("athletic ability," "creativity," "clarity of personal goals," "cheerfulness," "popularity with own sex," "popularity with opposite sex," "sensitivity to others," "personal appearance," "individuality," "writing ability," "self-respect," "drive to achieve," "social self-confidence," and "academic ability"; 1 = *much less*

than the average student of my age and gender, 6 = *much more than the average student of my age and gender*; $\alpha = .85$, $M = 3.94$, $SD = 0.70$). As an additional, convergent measure of self-enhancement, we administered the RSES (e.g., "I am satisfied with myself on the whole"; 1 = *strongly disagree,* 6 = *strongly agree*; $\alpha = .91$, $M = 4.66$, $SD = 0.99$). Consistent with the notion that they are both indicators of self-enhancement (Alicke & Sedikides, 2009; Sedikides & Gregg, 2008) and prior research documenting their robust association (Brown, 1986; Sedikides & Alicke, 2012; Taylor, Lerner, Sherman, Sage, & McDowell, 2003), the BTA task and RSES ratings were highly correlated, $r(93) = .61$, $p < .001$.

Results and Discussion

Zero-order and partial correlations. We present results in Table S1.1. Both nostalgia scales were positively correlated with both indicators of self-enhancement (Table S1.1, below diagonal). SNS scores were positively correlated with the BTA task and RSES). Likewise, TPI-PP was positively correlated with the BTA task and RSES. All associations remained significant after jointly controlling (in partial-correlation analyses) for extraversion, neuroticism, and interdependent self-construal (Table S1.1, below diagonal). Furthermore, all associations remained significant after individually controlling for extraversion, neuroticism, and interdependent self-construal. These results support the generality of the association between nostalgia and self-enhancement.

Potential pitfalls in testing unique associations. The partial correlation analyses demonstrated that the association between nostalgia (SNS and TPI-PP) and self-enhancement (BTA task and RSES) remained significant when controlling (jointly or individually) for extraversion, neuroticism, and interdependent self-construal. However, Westfall and Yarkoni (2016) recently showed that these analyses can lead one to incorrectly conclude that a unique association exists when, in fact, this is not the case (i.e., commit a Type 1 error). Specifically, they proposed that partial correlation analyses can exhibit high Type I error rates when (1) the control variable(s) is strongly correlated with the focal variables (here, nostalgia and self-enhancement), (2) sample size is large, and (3) reliability of the measures is moderate (between 0.3 and 0.7).

Fortunately, none of these three conditions was germane to the present study. First,

the correlations of the control variables with nostalgia and self-enhancement were small to moderate (Table S1.1). Second, sample size of the present study was not extremely large (N = 93). Although large sample size is generally desirable, Westfall and Yarkoni (2016) stated that "as samples grow, power to detect any reliable association between the predictors and the outcome necessarily increases. This remains true even when measurement unreliability causes the model to confuse a common effect of two or more predictors with a unique effect of one predictor" (p. 7). This cautionary note regarding very large samples does not apply to the present study. Third, scale reliabilities were equal to or greater than 0.80. As Westfall and Yarkoni pointed out, "when reliability is very high, the model is able to avoid misattributing the effect of the covariate to the predictor of interest" (p. 7).

These considerations notwithstanding, we followed Westfall and Yarkoni's (2016) recommendation to examine the influence of control variables with structural equation modeling. We treated the SNS and TPI-PP as indictors of a latent 'nostalgia' variable, and the BTA task and RSES as indicators of a latent 'self-enhancement' variable. Without control variables in the model, the correlation between these latent variables was: $\phi = .51$, $z = 4.50$, $p < .001$. Next, we conducted three separate analyses in which we accounted for role of the control variables: extraversion, neuroticism, and interdependent self-construal. We modeled each control variable as a latent variable with three indicators consisting of item parcels. In each analysis, we included paths from the relevant control variable to nostalgia and self-enhancement. We then tested the residual correlation between nostalgia and self-enhancement after accounting for the control variable. The residual correlations were: $\psi = .50$, $z = 4.61$, $p < .001$ when controlling for extraversion; $\psi = .51$, $z = 5.80$, $p < .001$ when controlling for neuroticism; and $\psi = .45$, $z = 4.18$, $p < .001$ when controlling for interdependent self-construal. In all, we observed very little, if any, attenuation of the robust positive association between nostalgia and self-enhancement when including the control variables.

Table S1.1.

Zero-Order Correlations among Measured Variables (Below Diagonal). Partial Correlations among Measures of Nostalgia and Self-Enhancement, Jointly Controlling for Extraversion, Neuroticism, and Interdependent Self-Construal (Above Diagonal).

Measure	SNS	PP-TPI	BTA task	RSES	Extraversion	Neuroticism	RISC
SNS	--	.60***	.25*	.36**			
PP-TPI	.61***	--	.25*	.47***			
BTA task	.31**	.34***	--	.48***			
RSES	.27**	.48***	.61***	--			
Extraversion	.27**	.15	.40***	.22*	--		
Neuroticism	.13	-.13	-.36***	-.59***	-.18	--	
RISC	.27**	.26*	.26*	.28**	.03	-.12	--

Note. We present zero-order correlations below the diagonal and partial correlations (jointly controlling for Extraversion, Neuroticism, and RISC scores) above the diagonal. $N = 93$.

* $p < .05$, ** $p < .01$, *** $p < .001$

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S2

Common Method Variance Test

To examine if common method variance (CMV) can account for the observed correlation between nostalgia and self-enhancement, we reported the results of Lindell and Whitney's (2001) partial correlation technique for controlling CMV. Their approach relies on identifying a marker variable that is theoretically unrelated to substantive variables (nostalgia, self-enhancement) in the study but is assessed with the same method. If the theoretical correlation between the marker variable and the substantive variables is 0, then unexpected nonzero correlations indicate the presence of CMV. Although the partial correlation approach is elegant in its simplicity, Williams, Hartman, and Cavazotte (2010) identified a number of limitations. To remedy these issues, they developed a Comprehensive Confirmatory Factor Analysis Marker Technique (CCFAMT). CCFAMT corroborated the results of Lindell and Whitney's partial correlation approach. Whereas CMV was present in both studies, it did not bias the correlation between nostalgia and self-enhancement.

Method

Measures

For Study 1, the maker variable is belief in just world, assessed by the scale provided in Dalbert (1999). For Study 2, the maker variable is online-shopping behaviors assessed by five 7-point scales pertaining to: online shopping frequency, frequency of groupon, frequency of buying virtual products, time spent online, and money spent online.

Analyses

We utilized CCFAMT to examine CMV in Studies 1 and 2. CCFAMT is based on a series of model comparisons. The first model, the CFA model (Figure S2.1), included all possible correlations among the two substantive latent variables (nostalgia proneness and self-enhancement) and the marker latent variable (belief in just world for Study 1; online-shopping behaviors for Study 2). This model served to obtain the factor loading and measurement error estimates for the indicators of the marker variable, which would be used in subsequent models.

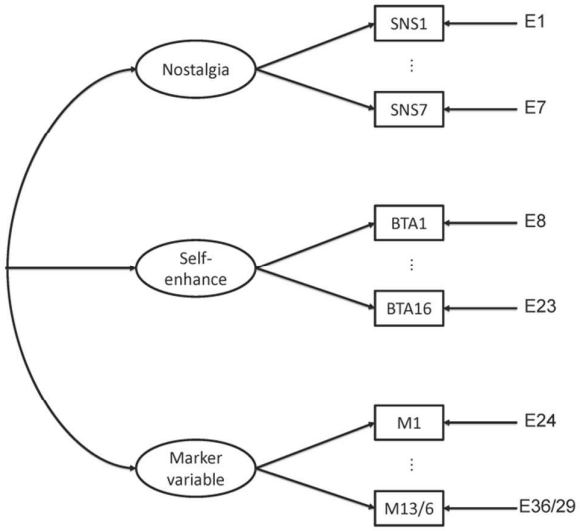

Figure S2.1 Confirmatory factor analysis (CFA) model. Note: Nostalgia proneness is represented with seven indicators (SNS1–SNS7) and associated factor loadings, self-enhancement is represented with sixteen indicators (BTA1–BTA16) and associated factor loadings, and the marker variable is represented with thirteen/six indicators (M1–M13/M6) in Study 1/2 and associated factor loadings.

In the second model, the Baseline Model (Figure S2.2), the latent variables of nostalgia and self-enhancement were correlated with each other. But neither of them was related to the marker latent variable, whose indicators having factor loadings and error variances fixed to the estimates from the CFA Model. Using fixed values in the Baseline Model and all subsequent models ensured that all subsequent model comparisons would focus only on method variance factor loadings (i.e., loadings from the indicators of nostalgia and self-enhancement to the marker latent variable).

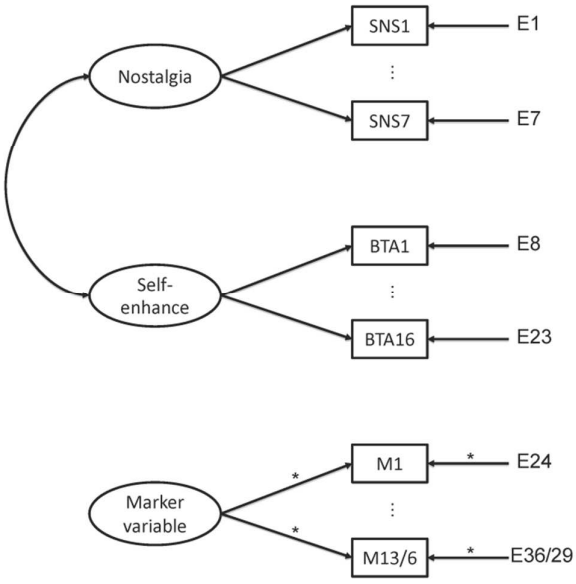

Figure S2.2 Baseline model. Note: Nostalgia proneness is represented with seven indicators (SNS1–SNS7) and associated factor loadings, self-enhancement is represented with sixteen indicators (BTA1–BTA16) and associated factor loadings, and the marker variable is represented with thirteen/six indicators (M1–M13/M6) in Study 1/2 and associated factor loadings. The * symbolizes parameters set at values obtained from the CFA Model.

The Method-C(onstrained) Model (Figure S2.3) resembled the Baseline Model in that the marker variable was assumed to be unrelated to the nostalgia and self-enhancement factors and the measurement parameters associated with its indicators are fixed. But the Method-C Model had additional factor loadings from the indicators of nostalgia and self-enhancement to the marker latent variable (represented with dashed lines in Figure S2.3). In accordance with the assumption of equal method effects, each of the marker variable factor loadings that relate to substantive items was constrained to be equal. The comparison of the Method-C Model with the Baseline Model tested the presence of equal method effects associated with the marker latent variable. In other words, a significant difference between the two models indicated the existence of CMV.

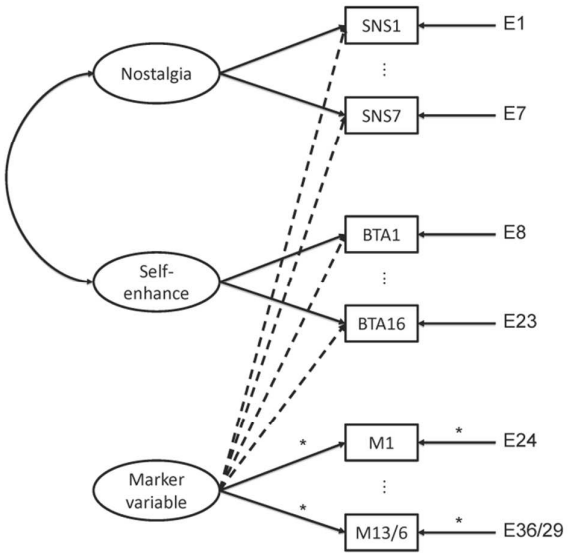

Figure S2.3 Method-C, Method-U, and Method-R Models. Note: Nostalgia proneness is represented with seven indicators (SNS1–SNS7) and associated factor loadings, self-enhancement is represented with sixteen indicators (BTA1–BTA16) and associated factor loadings, and the marker variable is represented with thirteen/six indicators (M1–M13/M6) in Study 1/2 and associated factor loadings. The * symbolizes parameters set at values obtained from the CFA Model. The dashed lines represent the 23 marker factor loadings that are forced to be equal in the Method-C Model and are freely estimated in the Method-U Model. In the Method-R Model, the factor correlation between nostalgia and self-enhancement is restricted to value obtained in the Baseline Model.

The Method-U(nconstrained) Model resembled the Method-C Model, except that the factor loadings of the substantive indicators on the marker variable could be freely estimated, thus reflecting the assumption that the marker variable was differentially related to substantive variables. A comparison of the Method-C and Method-U Models examined whether shared method effects were equivalent across substantive indicators.

Finally, the Method-R(estricted) Model used the obtained factor correlation for nostalgia and self-enhancement from the Baseline Model as a fixed (or restricted) value in either the Method-C or the Method-U Model (depending on which was supported). The comparison of either of the latter two models with the Method-R model assessed the biasing effects of CMV on the correlation between nostalgia and self-enhancement. If restricting the correlation between nostalgia and self-enhancement to the value obtained in the Baseline Model (which did not model CMV) results in reduced model fit compared to the Method-C or Method-U Model (which did model CMV), then the correlation between the substantive variables is biased by CMV.

Results

Table S2.1. Shared method effect test for Study 1

	χ^2	df	CFI
CFA	1529.383	591	0.703
Baseline	1534.168	618	0.710
Method-C	1517.309	617	0.715
Method-U	1504.255	595	0.712
Method-R	1517.312	618	0.715
Chi-square test	$\Delta\chi^2$	Δdf	χ^2 Critical value; .05
Baseline vs. Method-C	26.859*	1	3.84
Method-C vs. Method-U	13.054	22	33.92
Method-C vs. Method-R	0.003	1	3.84

Study 1

We compared the Baseline Model and Method-C Model to test the null hypothesis that the method factor loadings (assumed to be equal) linked with the marker variable were unrelated to each of the 23 substantive indicators (7 for nostalgia proneness, 16 for the BTA task). The comparison yielded a chi-square difference of 26.859 with one degree of freedom, which exceeded the 0.05 chi-square critical value for one degree of freedom of 3.84 (Table S2.1). The result provided support for rejecting the restriction to 0 of the 23 method factor loadings in the Baseline Model. This meant that shared method effects did exist.

Next, we performed a comparison between the Method-U and Method-C Models to test the null hypothesis that the influence of the method marker variable was equivalent for all of the 23 substantive indicators. The comparison yielded a chi-square difference of 13.054 with 22 degrees of freedom, which did not exceed the 0.05 critical value of 33.92 (Table S2.1). The chi-square difference testing did not support removing the constraints in the Method-C Model. Therefore, the Method-C Model represented the best model for accounting for marker variance on substantive indicators.

Finally, we determined whether the factor correlation was significantly biased by CMV by comparing the Method-C Model to the Method-R Model. The comparison resulted in a non-significant chi-square difference of 0.003 at one degree of freedom (Table S2.1). The model comparison showed that the effects of the marker variable did not significantly bias the factor correlation, though marker variable effects were significant in the Method-C model. Hence, there was no significant difference between the Baseline Model factor correlation (0.225) and the Method-C factor correlation (0.228). That is to say, the correlation between nostalgia and self-enhancement was not inflated by CMV.

Table S2.2. Shared method effect test for Study 2

	χ^2	df	CFI
CFA	3134.949	347	0.558
Baseline	3138.192	358	0.559
Method-C	3107.770	357	0.564
Method-U	2749.126	335	0.617
Method-R	2751.266	336	0.617
Chi-square test	$\Delta\chi^2$	Δdf	χ^2 Critical value; .05
Baseline vs. Method-C	30.422*	1	3.84
Method-C vs. Method-U	358.644*	22	33.92
Method-U vs. Method-R	2.140	1	3.84

Study 2

We compared the Baseline Model and Method-C Model to test the null hypothesis that the method factor loadings (assumed to be equal) associated with the marker variable were unrelated to each of the 23 substantive indicators (7 for nostalgia proneness, 16 for the BTAE). The comparison yielded a chi-square difference of 30.422 with one degree of freedom, which exceeded the 0.05 chi-square critical value for one degree of freedom of 3.84 (Table S2.2,). The result indicated support for rejecting the restriction to 0 of the 23 method factor loadings in the Baseline Model, thus sustaining the presence of CMV.

Next, we proceeded with a comparison between the Method-U and Method-C models to

examine the null hypothesis that the influence of the method marker variable was equivalent for all of the 23 substantive indicators. The comparison yielded a chi-square difference of 358.644 with 22 degrees of freedom, which exceeds the 0.05 critical value of 33.92 (Table S2.2). The result provided support for eliminating the restrictions in the Method-C Model. The Method-U Model, therefore, represented the best model for accounting for marker variance on substantive indicators.

Lastly, by comparing the Method-U and Method-R Models, we determined whether the factor correlation was significantly biased by CMV. The chi-square difference test resulted in a non-significant difference of 2.140 at one degree of freedom (Table S2.2). There was no significant difference between the Baseline Model factor correlation (0.225) and the Method-U factor correlation (0.202). In other words, the influence of CMV on the correlation between nostalgia and self-enhancement was negligible.

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