Brief report

Expressions of positive emotion in photographs, personality, and later-life marital and health outcomes ☆

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Abstract

A previous study of females at an elite liberal arts college found that the degree of positive emotion expressed in persons' college yearbook photos was correlated with personality, marital, and health outcomes decades later in life. We examine whether the same pattern is observed among respondents in the Wisconsin Longitudinal Study, using high school yearbook photographs and outcome measures obtained mostly when respondents were in their fifties. Despite some seeming advantages of our design, we were unable, with a few exceptions, to replicate the findings of the previous study. Possible explanations for this divergence in findings are discussed, including differences in measurement, the sample, and the photographic occasion itself.
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1. Introduction

Harker and Keltner (2001) found that how subjects smiled in their college yearbook photo was associated both with personality measures and with better marital and personal well-being outcomes two and three decades later. Their study sought to use yearbook smiles as an indicator of positive emotional expression, and their coding system sought to distinguish more "genuine" or "warm" smiles. As posited by Harker and Keltner, the expression of positive emotion in a yearbook photograph could be indicative of underlying and relatively stable personality traits that themselves contribute to better emotional well-being over the life course, which, in turn, has manifold other positive consequences. For that matter, the expression of positive emotion could be more directly causal—regardless of whatever it indicates about one's underlying feelings—by contributing to a positive impression on others and facilitating the development of more fulfilling interpersonal relationships. In sum, there is theoretical rationale for the associations Harker and Keltner observe, and their results are both strong enough to be significant in a sample of barely more than 100 subjects and robust enough to be little affected by the introduction of a control for physical attractiveness.

Even so, one might still doubt that so much can *really* be discerned about a person's personality—and moreover, about their future—from the way they smile in a single photograph. After all, one can buy the general premise that individual differences in emotion are highly consequential for personality and later-life outcomes, and yet still be skeptical of the effectiveness with which "positive emotion," as a putative individual characteristic, can be measured from one yearbook photograph. Additionally, Harker and Keltner's (2001) study is based on the Mills Longitudinal Study—a sample of women attending a highly exclusive college in Northern California (see Helson, 1967)—and so one might wonder whether the finding can be generalized to men, or even to a less select sample of women. These considerations motivated us to attempt to replicate and extend the Harker and Keltner study using similar methods and measures but a different and more diverse sample: the Wisconsin Longitudinal Study (WLS), which has followed a random sample of 1957 Wisconsin high school graduates since adolescence.

2. Data and measures

2.1. Data

The Wisconsin Longitudinal Study is based on a 1/3 sample of all Spring 1957 graduates of high schools in Wisconsin ($N = 10,317$). Respondents filled out an in-school questionnaire in 1957, and follow-up interviews with respondents were conducted in 1975 (when respondents were about 35 years old), 1993 (ages 53–54), and 2004 (ages 64–65; these data are in preliminary release at this writing). WLS respondents are also approximately the same age as respondents in the Mills Longitudinal Study (who were college graduates in 1958 or 1960). Because WLS respondents attended the same schools, obtaining the yearbooks for a large number of respondents was not impractical.

We sought to collect photos for a subsample of at least 3000 WLS respondents. Our sampling unit was schools, and all respondents from that school were included in the subsample if the school was selected. We sampled schools with a probability proportional to their size, so that all WLS respondents had an equal probability of being selected. Year-

books were obtained either by contacting the schools or libraries in the towns where the schools were located. Yearbooks were digitally reproduced using a high-quality scanner, and then respondents' senior photographs were extracted. We successfully obtained copies of 91% (93 out of 102) of the yearbooks we attempted to collect. Of the 3138 respondents in these yearbooks, 131 were either not pictured in their yearbook or not extracted due to problems with the photograph, resulting in a total sample size of 3007 respondents.[1] In addition, as we discuss below, we also collected 1956 yearbooks for six of the selected schools ($N = 258$ pictured respondents), for the purposes of examining the consistency of positive emotional expression in two photographs of the same person.

2.2. Positive emotional expression

We use a trichotomous measure of positive emotional expression, based first on whether the person in the photo was smiling and then, if smiling, whether this was a Duchenne smile (which involves movement of the muscles around the mouth and around the corners of the eyes). Following Harker and Keltner (2001), we relied upon the Facial Action Coding System (FACS) to identify Duchenne smiles (Ekman & Friesen, 1976, 1978; Ekman, Friesen, & Hager, 2002). A team of four coders (led and trained by a FACS-certified person) each individually coded all of the 1957 photos.[2] Coding was based on the presence or absence of Action Unit 6 (contraction of the orbicularis oculi muscle) and 12 (action of the zygomatic major muscle consistent with what is associated with a smile). A photo was coded as a Duchenne smile if the person was identified as contracting both Action Units 6 and 12, with the recognition the "crows feet" alone cannot be taken as an indicator of orbicularis oculi contraction (Ekman et al., 2002). A photo was coded as a non-Duchenne smile if the person only contracted Action Unit 12.

The initial agreement in codes between pairs of coders for each photo ranged from 73% to 80%.[3] Coders met under the supervision of the FACS-certified coder to resolve all disagreements. These meetings were conducted after each tenth of the sample had been coded to ensure that coders were consistent in their understanding of the protocol. The final measure is thus not a composite of individual codes but is based in the case of disagreement on a consensus judgment from a second assessment by coders together. We believe this protocol would help to reduce various possible sources of confusion that may result in "false positives" for Duchenne smiles; in any case, it seems unlikely these procedures would yield worse results in principle than a single FACS-certified coder working alone, as a FACS-certified coder did code all 1957 photos and participate in the resolution of disagreements. Harker and Keltner (2001, p. 115) did not use multiple coders for each photo; the agreement measure they report is based on a subsample and different metric but would not seem to indicate appreciably greater agreement among coders than what we observed.

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[1] Because the WLS contains so few non-whites (<2%), we also excluded these respondents on the grounds that a sample restricted to whites would provide the most straightforward opportunity for replication and that, if results were replicated, it would suggest the prospect of pursuing whether the findings were generalizable to other racial or ethnic groups in samples with more suitable numbers.

[2] The 1956 photos were coded later and by only one of the coders.

[3] Part of the disagreement was not on the substantive codes, but was in determining whether or not a photo could be coded. When photos for which codes were not assigned are removed, agreement ranges from 77% to 87%. The order of photos were randomized prior to coding, and no coder had knowledge of any outcome measure for any respondent.

By contrast, Harker and Keltner's measure of positive emotional expression was based on the sum of two five-point ratings for the intensity of contraction of each of the action units. We initially attempted to replicate this measure, but we were unsatisfied with the level of agreement across the four coders. Likewise, we also found it difficult to discern the position of the eye muscles in photographs in which the respondent was wearing glasses, and thus we excluded all such respondents from our coding.

2.3. Personality, marital, and well-being outcomes

As our first objective was replication of Harker and Keltner (2001), we constructed outcome measures as similar as possible to theirs. Accordingly, in describing these measures, we compare each to its counterpart in their study.

The self-reported personality measures examined by Harker and Keltner (2001) were taken from the Adjective Check List (Gough & Heilbrun, 1983). Positive emotional expression in the yearbook photos was hypothesized and found to be positively associated with "positive emotionality," "affiliation," and "competence," as well as inversely associated with "negative emotionality."[4] For each of the constructs Harker and Keltner examine, they indicate which of the dimensions from the five-factor model (McCrae & Costa, 2002) it most closely resembles: "positive emotionality" is said to most closely resemble Extraversion; "negative emotionality" most closely resembles Neuroticism; "affiliation" most closely resembles Agreeableness; and "competence" most closely resembles Conscientiousness.

In the 1993 WLS telephone and mail surveys, personality was assessed using short scales based on the five-factor model (two items per dimension on the phone interview; six items on the mail survey for all dimensions except Neuroticism, for which five items were used). For the results presented here, scores are standardized across all WLS respondents, and regression-based imputation was used for cases in which the phone interview was completed but the mail survey was not returned. Unstandardized alphas for the five scales are Neuroticism = .83, Extraversion = .82, Agreeableness = .74, Conscientiousness = .70, Openness = .69.

Harker and Keltner (2001) found positive self-expression to be related to both earlier marriage and to higher satisfaction among married respondents. Regarding marital history, the WLS contains sufficient information for us to reconstruct all the specific measures they used: married at age 27, never married by age 43, ever divorced by age 43. For 1993 survey non-respondents, we used 1975 data to construct whether respondent had married by age 27. Regarding marital satisfaction, Harker and Keltner looked at marital satisfaction at age 52 as measured on a five-point scale ranging from "not at all" satisfied to "very well" satisfied. In the 1993 WLS telephone survey, the most comparable item is one that asks the respondents to rate how "close" they are to their spouse on a four-point scale ranging from "not at all close" to "very close." As 80.5% of respondents said "very close" for this item, we converted the four-point scale to a binary measure that compares "very close" to other responses.

Harker and Keltner (2001) also found a significant relationship between positive emotional expression and a summary measure from the Well-Being scale of the California Psy-

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[4] "Affiliation" is examined by Harker and Keltner both as a cluster and as divided into nurturance and affiliation subscales.

chological Inventory, which combines emotional and physical health. We employ two separate measures of both physical and psychological health, drawing on items from the 1993 mail survey. For physical health, we use a self-reported global health measure (1 = "very poor"; 5 = "very good") and the number of different medical conditions for which the respondent reports having been diagnosed. For psychological well-being, we use a summary measure of psychological well-being drawn from the scales developed by Ryff (1989; Ryff and Singer, 1996) as well as a measure of depressed affect using the Center for Epidemiological Studies—Depression (CES-D) scale (Radloff, 1977).

2.4. Controls

To control for physical attractiveness, we recruited 33 different judges whose ages ranged from 63 to 91 years (mean of 78.5). All photos were rated by six men and six women using a photo-labeled 11-point rating scale [see Meland (2002) for details regarding scale development]. The resulting attractiveness score is based on the mean of the ratings given by these 12 coders after removing the highest and lowest score given. Average scores range from 2 to 10.5, with mean of 5.6.

As further controls, we use information in the WLS on student's class rank as well as their scores on an intendedly general cognitive ability test taken when respondents were juniors in high school (The Henmon–Nelson test of mental ability). We also include a control for parental socioeconomic standing that is based on a composite of parental education, income, and father's occupation and has been used in numerous past studies using the WLS.

3. Results

Tables 1 and 2 present results for simple bivariate comparisons for women and men, respectively. For each outcome, means are presented to compare those who were coded as producing a Duchenne smile, a smile that was not Duchenne, or no smile at all. Two-tailed *p*-values are presented for tests of differences in means (or proportions) between those with Duchenne smiles and those with non-Duchenne smiles, as well as between the Duchenne smiling group and both other groups.[5]

Looking first to the results for females, we see that women who produced Duchenne smiles in their senior photographs were significantly more likely than other women to report feeling "very close" to their spouses at age 53. However, no other significant results for women were observed. For men, we obtained a similar significant result for marital closeness, and men who produced Duchenne smiles in their senior photographs also reported significantly better health than men who produced non-Duchenne smiles. Again, however, no significant differences were observed for the majority of outcomes we examined. For both men and women, there was a tendency for the mean differences, even if non-significant, to be in the expected direction (10–3 for females and 9–4 for males). Given that

[5] Presented significance tests based on *t*-tests for non-binary outcomes and tests for proportions for binary outcomes. Mann–Whitney *U*-tests were also conducted for non-binary outcomes, with substantively equivalent results.

Table 1
Comparison of means by expression in 1957 yearbook photograph, WLS females

	(1) Duchenne smile	(2) Smile, not Duchenne	(3) No smile	p (1) vs. (2)	p (1) vs. (2) and (3)	N	In predicted direction?
Personality measures							
Extraversion	0.141	0.069	0.026	0.328	0.172	959	Yes
	(0.948)	(1.044)	(1.097)	(0.072)	(0.088)		
Neuroticism	0.134	0.191	0.265	0.453	0.191	962	Yes
	(1.031)	(1.035)	(0.972)	(0.056)	(0.084)		
Agreeableness	0.229	0.127	0.160	0.134	0.128	972	Yes
	(0.910)	(0.948)	(0.874)	(0.110)	(0.098)		
Conscientiousness	0.031	−0.024	−0.055	0.451	0.297	979	Yes
	(0.977)	(1.040)	(1.072)	(0.055)	(0.067)		
Marital outcomes							
Married by age 27	0.913	0.909	0.896	0.214	0.155	1092	Yes
	(0.282)	(0.288)	(0.306)	(0.013)	(0.030)		
Ever married by age 43	0.953	0.964	0.948	0.110	0.175	1092	No
	(0.212)	(0.187)	(0.222)	(0.055)	(0.023)		
Ever divorced at age 43	0.202	0.208	0.214	0.211	0.186	1044	Yes
	(0.402)	(0.406)	(0.411)	(0.014)	(0.020)		
Marital satisfaction at age 53	0.828	0.773	0.794	0.021	0.023	807	Yes
	(0.378)	(0.420)	(0.406)	(0.138)	(0.119)		
Well-being outcomes							
Self-reported health	4.199	4.188	4.157	0.841	0.634	822	Yes
	(0.659)	(0.611)	(0.776)	(0.016)	(0.033)		
# of reported symptoms	4.604	4.588	5.006	0.955	0.559	823	No
	(3.380)	(3.579)	(3.935)	(0.005)	(0.041)		
# of reported conditions	1.156	1.231	1.314	0.486	0.275	823	Yes
	(1.235)	(1.508)	(1.615)	(0.055)	(0.077)		
Psychological well-being	0.082	0.094	0.004	0.897	0.773	748	No
	(1.056)	(1.128)	(1.085)	(0.011)	(0.021)		
CES-D	9.299	9.366	9.681	0.926	0.764	751	Yes
	(8.940)	(8.435)	(7.368)	(0.008)	(0.022)		

Standard deviations for means and effect sizes (d) for significance tests in parentheses.

sample sizes were not especially small, however, this tendency would seem at best only weakly supportive of the expected relationship.

Given these largely null results, we conducted a number of additional exploratory analyses to determine whether positive results could be obtained either through more refined analyses (supplemental tables available from authors upon request). We first considered whether other variables might be suppressing the relationship between emotional expression and the various outcomes. Harker and Keltner (2001) examined whether their own results were affected by the introduction of a control for physical attractiveness. They considered attractiveness as a possible source of spuriousness for positive results, rather than a source of suppression for null results, but, even so, we estimated models in which Duchenne and non-Duchenne smiling groups were contrasted with the attractiveness measure included as a control. This did not change the statistical significance of any results, nor did it impressionistically change the results more toward the hypothesized results. Likewise, no result changed substantively when we estimated regression models in which we included high school test scores, high school class rank, and the 1957 socioeconomic status of parents.

Table 2
Comparison of means by expression in 1957 yearbook photograph, WLS males

	(1) Duchenne smile	(2) Smile, not Duchenne	(3) No smile	p (1) vs. (2)	p (1) vs. (2) and (3)	N	In predicted direction?
Personality measures							
Extraversion	−0.050	−0.171	−0.090	0.192	0.316	838	Yes
	(0.977)	(0.897)	(0.987)	(0.129)	(0.069)		
Neuroticism	−0.206	−0.156	−0.162	0.592	0.488	838	Yes
	(0.958)	(0.971)	(0.967)	(0.052)	(0.048)		
Agreeableness	−0.114	−0.049	−0.202	0.501	0.598	846	No
	(1.023)	(0.956)	(0.988)	(0.066)	(0.036)		
Conscientiousness	0.020	0.003	0.006	0.861	0.830	846	Yes
	(0.988)	(1.052)	(1.060)	(0.017)	(0.015)		
Marital outcomes							
Married by age 27	0.878	0.848	0.845	0.081	0.039	951	Yes
	(0.328)	(0.361)	(0.362)	(0.088)	(0.093)		
Ever married by age 43	0.972	0.963	0.945	0.150	0.026	951	Yes
	(0.166)	(0.188)	(0.228)	(0.046)	(0.106)		
Ever divorced at age 43	0.220	0.219	0.210	0.245	0.198	921	Yes
	(0.415)	(0.415)	(0.408)	(0.002)	(0.017)		
Marital satisfaction at age 53	0.835	0.766	0.761	0.021	0.004	738	Yes
	(0.372)	(0.425)	(0.427)	(0.173)	(0.181)		
Well-being outcomes							
Self-reported health	4.206	4.060	4.148	0.037	0.085	692	Yes
	(0.647)	(0.673)	(0.690)	(0.222)	(0.131)		
# of reported symptoms	3.699	3.453	3.494	0.419	0.339	693	No
	(2.906)	(2.628)	(3.316)	(0.089)	(0.073)		
# of reported conditions	0.891	0.957	1.059	0.580	0.146	693	No
	(1.150)	(1.020)	(1.389)	(0.061)	(0.111)		
Psychological well-being	−0.014	−0.010	−0.139	0.976	0.279	634	No
	(0.983)	(0.990)	(0.973)	(0.003)	(0.086)		
CES-D	7.863	8.028	7.881	0.841	0.910	646	Yes
	(7.449)	(7.038)	(7.647)	(0.023)	(0.009)		

Standard deviations for means and effect sizes (*d*) for significance tests in parentheses.

We next considered the possibility of suppression as the result of unmeasured heterogeneity across schools, either specifically in terms of some variable characteristics of the students or the photographing and printing process. We used fixed-effects regression models to examine this possibility, meaning that estimated effects compare students only with others in their same school. For females, this resulted in marginally significant results for the personality trait for agreeableness ($p = .06$) and for being married by age 43 ($p = .052$). For males, the association with self-reported health became slightly stronger and more significant ($p < .01$ bivariate). However, for both sexes, under the fixed-effects specification, the results for marital closeness that had been statistically significant were no longer so. Thus, taken together, these results were no more consistent with Harker and Keltner's results than were the simple comparisons of means.

As already noted, the Harker and Keltner sample was composed of college graduates, while only a minority of WLS respondents completed college (22%). We conducted analyses where we restricting the sample to college graduates, although this substantially reduced sample size (171 and below for females; 180 and below for males). While the mari-

tal closeness measure remained marginally significant for females, it was no longer so for males, although having ever been divorced was significant and in the predicted direction for males. Overall, there was no tendency for results to change in a direction consistent with those observed by Harker and Keltner (2001). Restricting the sample just to those who had completed at least one year of college, in order to have more observations to analyze ($Ns = 252$ and below for females; 275 and below for males), also did not affect the significance or substantive direction of results.

Together, these various sensitivity analyses fail to produce more convincing evidence of a relationship between our measure of positive emotional expression in the yearbook photo and the life outcomes under consideration. Given the large number of tests we conducted, one might wonder whether the significant results we did observe were really just the product of chance. We sought to determine whether, at least, the significant results we observed could be reproduced in the 2004 WLS data. For the marital closeness measure, however, results for females were not significant, and for males the only significant result was at the $p < .10$ level for the comparison of Duchenne smiling respondents versus all others. In the 2004 mail survey, the WLS asked questions about marital satisfaction, which was what Harker and Keltner examined, rather than just marital closeness. These results were also not significant and were not even in the predicted direction for males. Self-reported general health, which had been significant for males in the 1993 data, was not significant for males in 2004. In general, then, the few significant results that we did observe among respondents at age 53 were not observed among respondents at age 65.

Upon obtaining all these null results, we came to wonder about how consistent respondent smiles were over photographic occasions. The idea that a smile in a photograph could predict later-life outcomes seems predicated, at the very least, on the smile captured in this single, preserved moment being substantially related to the smile that would be captured in other, similar moments. For a small subsample of respondents, we collected 1956 yearbooks and extracted the photographs of respondents from their junior years. The resulting samples are small, but, surprisingly, for those who produced a codeable smile in both years, those who produced a Duchenne smile in 1957 were, if anything, *less* likely to have done so in 1956 (15 of 36, 42%) than were those who produced a non-Duchenne smile as a junior (11 of 19, 58%). In other words, producing a Duchenne smile in one wave was not at all positively predictive of producing a Duchenne smile in the other. By contrast, those who smiled (Duchenne or not) in 1957 were more likely to have also smiled in 1956 (43 of 55, 78%) than those who did not smile in 1957 (19 of 49, 39%). We also examined the relationship between smiling in the 1956 photos and the various outcomes we have considered, and, while sample sizes were again small, no result was close to be significant in the expected direction (all $p > .25$), nor were the results more often in the expected direction than they were in the analysis of 1957 photographs. If there is not a strong relationship between the positive emotional expression evinced in school photographs across occasions, then the potential causal potency of any single photograph would seem to require an argument about how a particular photographic occasion would produce an especially good indicator of more durable states.

4. Discussion

With a few exceptions, we failed to find any significant difference in personality, marital, or well-being outcomes that was associated with how respondents smiled in their high

school yearbooks. Moreover, the significant differences we did find did not seem particularly robust. The results differ markedly from Harker and Keltner (2001), who found striking and significant results in a far smaller sample. How could two studies yield such contrary conclusions? The most obvious suspects would seem to be differences between our study and theirs either in the measures that were employed or in the composition of samples.

Harker and Keltner summed separate five-point ratings of the extremity of movements of the two relevant facial Action Units. In contrast, we were not satisfied with the interrater reliabilities that we achieved in attempting to replicate this measurement strategy, and so instead we rated the photos only as to whether or not respondents smiled and whether, if a smile was produced, it could be classified as a Duchenne smile. If the substantive import of this change in measurement was just that we were measuring the same relationships only with more coarse categorization, then we would have still expected to observe significant results, as simulated power analyses confirm that the increase in sample size was easily enough to compensate for the loss of precision in measurement. However, it could be that the meaningful variation in the Harker and Keltner data is not between those who do and not produce Duchenne smiles but between those who produce more or less intense Duchenne (or not Duchenne) smiles.

Although both studies relied on photographs taken between 1956 and 1960, Harker and Keltner's study was based on college yearbook photographs, while ours was based on high school yearbook photographs. Possibly, one could offer some developmental hypothesis for why positive expression would be associated with various outcomes in one's early twenties but not late teens. Or, perhaps the picture-taking or selection process for the Mills yearbooks yielded photos where the smiles were better indicators of the pertinent expressive traits. Unfortunately, little is known about these processes for either sample. However, if Mills students had more discretion over the particular shot and/or pose that went into the yearbook, differences in the combination of taste and self-concept that go into the selection could itself be correlated with outcomes. Notable in this regard is that, in the WLS, we failed to find enough stability in smiles for those respondents for which we had two photographs to be confident that we were measuring an individual trait.

Additionally, while neither sample is representative of Americans, the Mills Longitudinal Study is a sample of female college graduates from an elite college, while the WLS is drawn from a cohort of all high school graduates from an entire state. Even when the WLS sample is restricted to only its members who graduated from college, the sample is still far less socially elite than the Mills sample; not enough WLS females attended schools as elite as Mills to make a sample that would truly comparable in this regard. One could speculate that positive emotion carried some greater interactional or other returns for the Mills graduates than it did for the WLS graduates. If so, of course, the relevance of the Harker and Keltner findings toward any general statements about positive emotional expression and later-life outcomes would seem quite limited.

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Wisconsin Longitudinal Study (WLS) [graduates and siblings]: 1957–2004. [Data file] <http://www.ssc.wisc.edu/~wls/>.