
Laughter and Resiliency: A Behavioral Genetic Study of Humor Styles and Mental Toughness

Livia Veselka,¹ Julie Aitken Schermer,² Rod A. Martin,¹ and Philip A. Vernon¹

¹ Department of Psychology, University of Western Ontario, Canada

² Management and Organizational Studies, University of Western Ontario, Canada

This study investigated phenotypic correlations between mental toughness and humor styles, as well as the common genetic and environmental effects underlying these correlations. Participants were 201 adult twin pairs from North America. They completed the Humor Styles Questionnaire, assessing individual differences in two positive (affiliative, self-enhancing) and two negative (aggressive, self-defeating) humor styles. They also completed the MT48, measuring individual differences in global mental toughness and its eight factors (Commitment, Control, Emotional Control, Control over Life, Confidence, Confidence in Abilities, Interpersonal Confidence, Challenge). Positive correlations were found between the positive humor styles and all of the mental toughness factors, with all but one reaching significance. Conversely, negative correlations were found between all mental toughness factors and the negative humor styles, with the mental toughness factors of Control, Emotional Control, Confidence, Confidence in Abilities, and Interpersonal Confidence exhibiting significant correlations. Subsequent behavioral genetic analyses revealed that these phenotypic correlations were primarily attributable to common genetic and common non-shared environmental factors. The implications of these findings regarding the potential effects of humor styles on wellbeing, and the possible selective use of humor by mentally tough individuals are discussed.

Keywords: humor styles, mental toughness, twin study

When first subjected to psychological inquiry, humor was typically defined as a one-dimensional construct that was assumed to be consistently beneficial for physical and psychological health (e.g., Lefcourt, 2001). Indeed, following the personal account of Cousins (1979), who popularized the notion of humor and laughter as a key factor in coping with physical illness, a prevalent theme in humor research was the positive effects of humor on overall wellbeing (Martin, 2001). In earlier research, this one-dimensional construct of humor, measured with several different scales, was linked to various aspects of health and

wellbeing, including better immune functioning (Dillon et al., 1985), higher self-esteem and optimism (Kuiper & Martin, 1993), and lower levels of depression and anxiety (Thorson et al., 1997). It was further shown to moderate the impact of stressors on mood disturbance (e.g., Martin & Lefcourt, 1983; Nezu et al., 1988) and immunity (Martin & Dobbin, 1988; for a review of this research, see Martin, 2007).

As interest has grown in the idea of ‘sense of humor’ as a stable personality trait, a more multifaceted understanding of the construct has emerged (Ruch, 1998). Rather than being viewed as a coping skill consistently associated with improved functioning, sense of humor is now conceptualized as a collection of loosely related components, which may not all contribute positively to wellbeing. Epitomizing this multidimensional perspective is the proposal that there are four humor styles, two positive and two negative, which represent different ways of using and expressing humor (Martin et al., 2003). On the positive side, the *affiliative* humor style is characterized by a tendency to joke with others in order to create and strengthen interpersonal bonds, while the *self-enhancing* humor style is defined by the use of humor to maintain a positive outlook on life, regulate emotions, and cope with difficult situations (Martin et al., 2003). On the negative end, the *aggressive* humor style entails the use of sarcasm and teasing to enhance oneself at the expense of others, while the *self-defeating* humor style involves the use of self-disparaging humorous remarks in an effort to create bonds with others at the expense of the self (Martin et al., 2003).

While these four humor styles have been assessed in relation to a variety of different traits representing psychological wellbeing or the lack thereof (e.g., Frewen et al., 2008; Martin et al., 2003; Veselka et al., 2010), they have not yet been examined in association

Received 16 June, 2010; accepted 5 July, 2010.

Address for correspondence: Livia Veselka, Department of Psychology, University of Western Ontario, London, Ontario, Canada N6A 5C2.
E-mail: lveselka@uwo.ca

with the construct of mental toughness — the ability to thrive when faced with adversity (Clough et al., 2001). Given the close ties demonstrated between coping and humor as it was traditionally defined (e.g., Kuiper & Martin, 1998; Kuiper et al., 1993; Lefcourt & Martin, 1986), an investigation of the relations between a more multidimensional view of humor and mental toughness could further clarify the role of humor in the context of wellbeing. Moreover, a behavioral genetic investigation of the potential links between these constructs could help to uncover common etiological factors underlying them.

Mental Toughness

The construct of mental toughness was born out of research on human hardiness — the ability to exhibit resiliency in the face of high stress (Kobasa, 1979; Kobasa et al., 1982). By studying the effects of stressful life events on illness onset, Kobasa (1979) proposed that the construct of hardiness is made up of three elements: *Commitment*, *Control*, and *Challenge*. Commitment is defined by an overall sense of purpose in life that drives individuals to actively approach and find meaning in the events they encounter. Control represents the tendency to feel as though one is influential rather than helpless in situations of adversity. Finally, Challenge is characterized by the belief that change is normal in life, and that it can stimulate growth rather than threatening one's security.

Mental toughness, as defined by Clough et al. (2001), is an extension of this construct of hardiness and its three components. Specifically, in addition to the three factors defining hardiness, mental toughness is further characterized by a fourth factor — that of *Confidence*, as defined by a high sense of self-belief. Clough et al. (2001) argued that this fourth dimension is a necessary component of human resiliency, given their finding that Commitment, Control, and Challenge alone could not explain the ability of individuals to remain relatively unaffected by adversity. In addition, the authors further expanded upon the notion of mental toughness by adding sub-components to two of the three original factors of the construct. Specifically, they described Control as comprising Emotional Control and Control Over Life, and Confidence as being made up of Confidence in Abilities and Interpersonal Confidence.

Humor Styles and Mental Toughness: Common Personality Correlates

To date, there exists no research assessing possible relations between humor styles and the four factors of mental toughness. However, studies have investigated these two sets of constructs individually in relation to other higher-order personality dimensions and outcomes. Patterns of results derived from these studies provide an initial glimpse into potential associations that may exist between humor styles and mental toughness.

Both mental toughness and humor styles have been investigated in relation to the Big Five factors of personality. The Big Five model is the currently conventional framework of personality, which posits that all individual differences in human personality can be accounted for by five trait dimensions: Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (Costa & McCrae, 1992). Martin et al. (2003) first examined the correlations between the humor styles and the Big Five traits, noting that the positive humor styles were significantly and positively associated with Extraversion and Openness and that the negative humor styles correlated negatively with Agreeableness and Conscientiousness, and positively with Neuroticism. In addition, self-enhancing humor was negatively correlated with Neuroticism. Vernon et al. (2008) replicated the findings of Martin et al. (2003), and also reported a few additional phenotypic correlations. Specifically, for the positive humor styles, they observed a positive association between self-enhancing humor and Conscientiousness, and a negative correlation between affiliative humor and Agreeableness. For the negative humor styles, Vernon et al. also noted a small but significant positive relation between the negative expressions of humor and Openness. Overall, the general pattern of results suggests that the negative humor styles have more antisocial underpinnings given their positive association with Neuroticism, while the positive humor styles may have more prosocial qualities in light of their strong associations with traits such as Extraversion and Openness and negative association with Neuroticism (Martin et al., 2003).

Mental toughness has also been examined in relation to the Big Five factors of personality. Horsburgh et al. (2009) reported a number of significant phenotypic correlations between mental toughness and the Big Five model. They found that global mental toughness and all mental toughness factors were significantly negatively associated with Neuroticism, and significantly positively related with Conscientiousness. Significant positive correlations were further noted between most of the mental toughness variables and the remaining Big Five factors, with Extraversion exhibiting the strongest correlations. Veselka et al. (2009) further confirmed this pattern of findings by extracting one general factor of personality (GFP) from the Big Five dimensions and the mental toughness factors. They found that all of the mental toughness factors as well as Big Five Extraversion, Openness, Agreeableness, and Conscientiousness exhibited moderate to high positive loadings on the GFP, whereas Neuroticism loaded strongly and negatively. Taken together, these results depict mental toughness as a beneficial trait, and individuals possessing it as emotionally stable, outgoing, and intellectually open.

In addition to being assessed in relation to higher-order dimensions, the humor styles and mental

toughness variables have also been studied in relation to other personality traits. For instance, effective coping strategies have been found to correlate negatively with the negative humor styles and positively with the positive humor styles (e.g., Erickson & Feldstein, 2007). Similarly, mental toughness has been linked to more effective coping strategies (e.g., Kaiseler et al., 2009). Further, both positive humor styles and a mentally tough disposition have been shown to have a buffering effect against poor psychological health (e.g., Frewen et al., 2008; Maddi et al., 2006), as well as poor physical health (e.g., Martin et al., 2003; Sheppard & Kashani, 1991). These variables common to both sets of constructs further suggest possible correlations between humor styles and mental toughness.

Behavioral Genetic Investigations of Humor Styles and Mental Toughness

Although no bivariate behavioral genetic investigations have been carried out on the humor styles and mental toughness variables, univariate studies of each of the constructs have been conducted. These studies reveal the extent to which individual differences in the constructs can be accounted for by genetic and/or environmental factors. As a result, they provide a good starting point for further behavioral genetic research at the bivariate level.

Vernon et al. (2008b) conducted a univariate behavioral genetic investigation of humor styles using a North American adult twin sample. They reported that individual differences in the positive humor styles were primarily attributable to additive genetic and non-shared environmental factors, whereas individual differences in the negative humor styles were largely attributable to shared and nonshared environmental factors. Such findings would seem to suggest that negative humor styles develop mainly as a consequence of learning experiences, while positive humor shows some degree of heritability. Univariate behavioral genetic studies of the humor styles were also carried out in the United Kingdom, however, where it was found that individual differences in all four styles were accounted for entirely by genetic and nonshared environmental factors (Vernon et al., 2008). The researchers suggested that the difference between these studies might be due to cultural differences between the two countries resulting in different patterns of selection.

Horsburgh et al. (2009) carried out a univariate behavioral genetic analysis of mental toughness using a North American twin sample. As they predicted, the researchers noted that genetic and non-shared environmental effects contributed to individual differences in all the facets of the construct.

Present Study

The purpose of the present study was to determine the phenotypic correlations that may exist between the four humor styles and several dimensions of mental toughness. Additionally, we wished to investigate the

extent to which any phenotypic correlations that emerge are attributable to correlated genetic and/or correlated environmental factors.

Significant phenotypic correlations were expected to emerge between the humor styles and the factors of mental toughness given their individual associations with common personality dimensions and traits. Specifically, it was predicted that the two positive humor styles would correlate positively with the mental toughness factors as well as with global mental toughness, given that all of these variables have shown relations with prosocial and beneficial personality factors and outcomes, including Big Five Extraversion and Openness, effective coping, and physical as well as psychological health (e.g., Horsburgh et al., 2009; Martin et al., 2003; Vernon et al., 2008b). Alternatively, the negative humor styles were predicted to exhibit negative associations with mental toughness, in light of their reported associations with more antisocial and negative traits and outcomes, such as Big Five Neuroticism, diminished coping, and reduced wellbeing. Based on previous research with these and other variables, bivariate behavioral genetic analyses of humor styles and mental toughness were expected to show that observed correlations between them are primarily attributable to common genetic and common non-shared environmental factors.

Method

Participants

Participants were 201 pairs of adult twins: 152 MZ pairs and 49 DZ pairs. They lived in the United States and Canada and were a sub-sample of twins who had taken part in previous research projects conducted by our lab. The twins ranged between 17 and 92 years in age ($M = 41.42$, $S = 17.54$).

Materials

Humor Styles Questionnaire (HSQ). The HSQ (Martin et al., 2003) was used to measure individual differences in the four humor styles (affiliative, self-enhancing, aggressive, self-defeating). This questionnaire comprises 32 items, each presenting a self-reflective statement regarding humor. Participants used a 7-point Likert Scale (where 1 = *Totally disagree* and 7 = *Totally agree*) to indicate the extent to which they agreed with each item. Cronbach alpha values for the humor style scales range from .77 (aggressive humor) to .81 (self-enhancing humor; Martin et al., 2003).

MT48. The 48-item MT48 (Clough et al., 2001) was used to assess mental toughness. This questionnaire measures individual differences in global mental toughness, as well as in its four subscales: Challenge, Commitment, Control, and Confidence. Of these subscales, Confidence and Control each consist of two parts: Confidence in Abilities and Interpersonal Confidence make up the former, while Emotional Control and Control over Life comprise the latter. In

the present sample, the reliabilities of these the MT48 scales ranged from .74 (Challenge, Control) to .92 (Overall mental toughness).

Procedure

In 2006, participants were recruited via newspaper advertisements to participate in an ongoing study of personality in adult twins. They replied to these advertisements by telephone or by e-mail, at which point the details of the study and the nature of their participation in it were described. Individuals who agreed to take part in the study were then sent a package through standard mail containing the HSQ, a zygosity questionnaire, as well as additional questionnaires not relevant to the present study. In 2008, a portion of these twins was invited to complete the MT48 in addition to other measures not pertinent to this report. In each of these mail-outs, participants were asked to fill out the questionnaires individually, and then to return the completed questionnaires using self-addressed stamped envelopes with which they were provided. Participants received \$20.00 for taking part in each mail-out, and were entered in a draw to win one of ten \$100.00 prizes each time. Over 96% of the individuals who agreed to take part in the 2008 mail-out returned their completed questionnaires.

Analyses

Nearly all twins participating in the present study fully completed the HSQ and the MT48. However, rare instances did arise in which an item was left blank. In these instances, we replaced the missing information with the average of that particular item's Likert Scale. Given the range of ages comprising the present sample, and the uneven distribution of males and females, all data were corrected for age and sex via the regression approach proposed by McGue and Bouchard (1984). Finally, the items of the HSQ were converted to four scores reflecting the four major humor styles, and the items of the MT48 were reduced to eight scores — one representing global mental toughness, and the remaining scores corresponding to the factors comprising the global construct.

We conducted the bivariate behavioural genetic analyses using the Mx software package (Neale et al., 2006) to determine the extent to which phenotypic correlations between humor and mental toughness can be accounted for by common genetic and/or common environmental factors. For this analysis, we used the method of Cholesky or triangular factor analysis (Neale & Cardon, 1992) to assess the cross-correlations within twin-pairs (i.e., the correlation between one twin's score on one variable with their co-twin's score on another variable). We began by fitting a full ACE model to our data to investigate potential correlated genetic (A), common environmental (C), and/or unique environmental (E) effects. Subsequently, reduced AE and CE models were tested. The models with the lowest chi-square change value (relative to the full model) and the lowest AIC value were selected as

Table 1

MZ and DZ Twin Correlations for the Humor Style and Mental Toughness Variables

Humor styles	MZ correlations	DZ correlations
Affiliative	.50	.27
Self-enhancing	.46	.06
Aggressive	.50	.40
Self-defeating	.37	.36
Mental toughness		
Challenge	.47	.08
Commitment	.37	.05
Control	.44	.04
Emotional control	.54	.16
Control over life	.46	.22
Confidence	.47	.01
Confidence in abilities	.50	.10
Interpersonal confidence	.40	.20
Global mental toughness	.54	.02

the best-fitting models. For each of the correlations presented in Table 1, a reduced AE model was deemed to have the best fit. Consequently, genetic (rg) and non-shared environmental (re) correlations were estimated.

Results

MZ and DZ twin correlations for the humor style and mental toughness variables are reported in Table 1. Not surprisingly — given that the twins in the present study were a subset of the samples tested by Vernon et al. (2008b) and Horsburgh et al. (2009) — these twin correlations are very similar to those reported in our earlier studies.

Phenotypic correlations between the four humor styles, and the components of mental toughness are shown in Table 2. Significant positive associations were found between the two positive humor styles and all but one of the measured mental toughness variables. Specifically, the correlation between affiliative humor and Control over Life did not reach significance, although a significant correlation did emerge between self-enhancing humor and this mental toughness variable. The majority of the significant correlations between the positive humor styles and mental toughness were moderate in magnitude, with the highest significant association emerging between self-enhancing humor and Emotional Control (.41), and the lowest between affiliative humor and Control (.14).

Fewer significant associations were noted between the negative humor styles and the mental toughness variables, although all but one of these correlations was negative. The only positive correlation was between aggressive humor and Interpersonal Confidence. Significant negative correlations were noted between both negative humor styles and the mental toughness factors of Control, Confidence,

Table 2
Phenotypic, Genetic, and Environmental Correlations Between Humor Styles and Mental Toughness

Mental toughness factors	Humor styles			
	Affiliative	Self-Enhancing	Aggressive	Self-defeating
Commitment	rp = .18** rg = .06 (-.23 to .32) re = .22 (.06 to .36)	rp = .25** rg = .42 (.12 to .72) re = .15 (.01 to .30)	rp = -.11* rg = -.23 (-.49 to .05) re = -.07 (-.22 to .08)	rp = -.08 rg = — re = .01 (-.13 to .14)
Control	rp = .14** rg = .15 (-.08 to .37) re = .14 (-.02 to .28)	rp = .33** rg = .64 (.42 to .85) re = .11 (-.04 to .26)	rp = -.13** rg = -.21 (-.44 to .02) re = -.09 (-.24 to .07)	rp = -.14** rg = -.21 (-.47 to .06) re = -.07 (-.22 to .08)
Emotional control	rp = .33** rg = .31 (.09 to .49) re = .40 (.25 to .52)	rp = .41** rg = .61 (.39 to .80) re = .27 (.11 to .41)	rp = -.01 rg = -.02 (-.25 to .20) re = .01 (-.15 to .16)	rp = -.18** rg = -.36 (-.12 to -.60) re = -.04 (-.19 to .11)
Control over life	rp = .01 rg = -.04 (-.29 to .19) re = .07 (-.08 to .22)	rp = .25** rg = .48 (.24 to .71) re = .10 (-.05 to .25)	rp = -.11* rg = -.26 (-.02 to -.50) re = -.01 (-.15 to .15)	rp = -.08 rg = -.07 (-.34 to .21) re = -.06 (-.19 to .08)
Confidence	rp = .24** rg = .32 (.08 to .53) re = .15 (-.01 to .30)	rp = .31** rg = .65 (.40 to .89) re = .08 (-.07 to .23)	rp = -.11* rg = -.11 (-.35 to .15) re = -.14 (-.28 to .01)	rp = -.16** rg = -.22 (-.49 to .07) re = -.10 (-.25 to .05)
Confidence in abilities	rp = .23** rg = .22 (-.01 to .43) re = .27 (.12 to .41)	rp = .40** rg = .62 (.39 to .82) re = .23 (.08 to .38)	rp = -.10* rg = -.10 (-.32 to .14) re = -.09 (-.24 to .07)	rp = -.19** rg = -.30 (-.04 to -.55) re = -.10 (-.25 to .05)
Interpersonal confidence	rp = .38** rg = .37 (.15 to .55) re = .41 (.27 to .53)	rp = .29** rg = .46 (.21 to .69) re = .20 (.05 to .35)	rp = .12** rg = .09 (-.15 to .32) re = .12 (-.03 to .27)	rp = -.10* rg = -.36 (-.10 to -.63) re = .06 (-.09 to .21)
Challenge	rp = .20** rg = .14 (-.11 to .36) re = .24 (.09 to .38)	rp = .36** rg = .56 (.31 to .78) re = .24 (.09 to .38)	rp = -.05 rg = -.17 (-.42 to .08) re = .03 (-.12 to .18)	rp = -.07 rg = -.26 (-.55 to .02) re = .04 (-.11 to .18)
Global mental toughness	rp = .26** rg = .20 (-.02 to .40) re = .31 (.16 to .45)	rp = .40** rg = .63 (.41 to .82) re = .23 (.08 to .38)	rp = -.08 rg = -.16 (-.38 to .07) re = -.04 (-.19 to .11)	rp = -.15** rg = -.31 (-.06 to -.56) re = -.02 (-.17 to .13)

Note: rp = phenotypic correlation. rg = genetic correlation. re = non-shared environmental correlation. Numbers appearing in brackets represent the 95% confidence interval values. All correlations whose confidence intervals do not include zero are significant at the .05 level.

Confidence in Abilities, and Interpersonal Confidence. Additional significant negative correlations were found between aggressive humor and the mental toughness factors of Commitment and Control over Life, and between self-defeating humor and the mental toughness variables of Emotional Control and global mental toughness. All of the correlations were smaller in comparison to those involving the positive humor styles, with the highest significant association being between self-defeating humor and Confidence in Abilities (-.19), and the lowest between self-defeating humor and Interpersonal Confidence (-.10).

Results from the bivariate behavioral genetic analysis are also shown in Table 2, and reveal that the phenotypic correlations noted above were primarily attributable to common genetic and common non-shared environmental factors. With regard to the positive humor styles, significant genetic correlations were noted between self-enhancing humor and all mental toughness variables. For affiliative humor, significant genetic correlations were observed with the mental toughness factors of Emotional Control, Confidence, and Interpersonal Confidence. For the negative humor styles, significant genetic associations were seen between aggressive humor and Control over

Life, and between self-defeating humor and Emotional Control, Confidence in Abilities, Interpersonal Confidence, and global mental toughness. Several of the genetic correlations — particularly those between the positive humor styles and mental toughness — were quite large (e.g., .65 between self-enhancing humor and Confidence, .64 between self-enhancing humor and Control).

With regard to correlated environmental effects, significant nonshared environmental correlations were observed between the two positive humor styles and Commitment, Emotional Control, Confidence in Abilities, Interpersonal Confidence, Challenge, and global mental toughness. None of the non-shared environmental correlations between the negative humor styles and the mental toughness variables reached significance. No shared environmental correlations were noted between any of variables.

Discussion

The present study represents the first investigation of phenotypic correlations between humor styles and mental toughness, and is also the first bivariate behavioral genetic study of relationships between the two constructs. The analyses were carried out to clarify

ties between humor and human resiliency in order to test the traditional notion that humor always yields beneficial outcomes (Martin et al., 2003).

The pattern of phenotypic correlations reported in the present study largely confirmed our initial predictions. For the positive humor styles, the expected positive associations between the mental toughness variables and the affiliative and self-enhancing humor styles were observed. It is possible that these correlations reflect the common underlying higher-order dimensions and outcomes shared by all of the variables. Specifically, the positive associations between affiliative humor, self-enhancing humor, and the majority of the mental toughness factors may reflect the fact that all of these traits are also positively associated with the Big Five factors of Extraversion, Openness, and Conscientiousness and (with the exception of affiliative humor) negatively associated with Neuroticism (e.g., Horsburgh et al., 2009; Martin et al., 2003; Vernon et al., 2008b), which implies an outgoing, inventive, emotionally stable, and attentive personality. Furthermore, both the positive humor styles and mental toughness factors have been linked to physical and psychological well-being, as well as to better coping (e.g., Erickson & Feldstein, 2007; Frewen et al., 2008; Kaiseler et al., 2009; Maddi et al., 2006), which suggests that this prosocial type of personality may have positive health implications (Martin et al., 2003). In particular, it may be the case that mentally tough individuals make conscious use of both affiliative and self-enhancing humor styles, which allow them to gain and maintain social support — a buffer against psychological and physiological distress in itself (e.g., Uchino et al., 1996) — and to view the world in an optimistic way. In turn, positive health-related outcomes may result.

With regard to the negative humor styles, both aggressive and self-defeating humor exhibited negative (although not always significant) correlations with the mental toughness factors, hence largely supporting our predictions. As with the positive humor styles, these negative associations may stem from the higher-order personality traits common to both constructs, as well as from the similar outcomes shared by both. In particular, the phenotypic correlations observed in the present study may be a result of the fact that while mental toughness has been shown to correlate negatively with Big Five's Neuroticism, and positively with the remaining four Big Five factors, the negative humor styles have exhibited the opposite pattern of correlations (e.g., Horsburgh et al., 2009; Martin et al., 2003; Vernon et al., 2008b). These differing associations suggest that while mental toughness implies a prosocial type of personality, the negative humor styles are more reflective of emotional instability and decreased sociability. The fact that mental toughness has been linked to positive physical and psychological outcomes, whereas the opposite pattern of associations has been found with negative humor styles

(particularly self-defeating humor), may further suggest that an emotionally unstable personality has negative implications for one's overall wellbeing (e.g., Kaiseler et al., 2009; Martin et al., 2003). Specifically, it may be the case that individuals who lack mental toughness are more prone to employ aggressive and self-defeating humor, which creates a social distance between themselves and others and has deleterious implications for their sense of self-worth. As a result, negative health outcomes are achieved.

Apart from these predicted correlations, some other unexpected associations or lack thereof were also noted. For instance, no significant relation was observed between affiliative humor and the mental toughness factor of Control over Life. This observation may have resulted from the fact that, in a social context, the notion of control has been shown to be a complex one. While the mental toughness factor of Control has been linked to prosocial personality traits and outcomes, the idea of control in an interpersonal context has shown associations with decreased relationship satisfaction and poor peer evaluations (e.g., Sanders & Malkis, 1982; Zak et al., 1997). Specifically, it may be the case that while feelings of control or a need for control are beneficial on an individual level, they may be deemed threatening in a social context. As a result it is possible that although individuals who use an affiliative humor style may like to feel in control, they do so cautiously and selectively given their interpersonal interests. As a result of this complex role of control, the relation between Control over Life and affiliative humor may have been attenuated.

An unexpected correlation was the significant positive association observed between the aggressive humor style and Interpersonal Confidence. However, upon reflection, a relation between these two variables is not entirely unusual. For instance, it has been shown that individuals who are aggressive or socially manipulative are often popular among their peers, which instills in them a sense of social competence (e.g., Andreou, 2006; Dijkstra et al., 2009). Thus, it is possible that in the present study participants with a tendency toward aggressive humor were more likely to rate themselves as interpersonally confident.

Results from the bivariate behavioral genetic analyses also supported our predictions. Specifically, the phenotypic correlations that emerged between the constructs were largely attributable to correlated genetic effects, and secondarily (in most cases) to correlated nonshared environmental effects. These results suggest the role of common heritability and learning experiences in the emergence of individual differences in mental toughness and humor styles. Our finding of an important genetic component in these correlations also suggests that there may be an evolutionary basis to the association between humor styles and mental toughness (for evolutionary theories of humor, see Gervais & Wilson, 2005; Weisfeld, 2006).

The absence of significant nonshared environmental influences underlying the phenotypic correlations between the negative humor styles and mental toughness was an unexpected result. It suggests that there is no learned component accounting for the observed association between the traits, and therefore puts an emphasis on shared genetic factors. The finding is particularly interesting given previous research that has attributed individual differences in the negative humor styles at the univariate level to learning experiences only (e.g., Vernon et al., 2008b).

Through our study, we have added further support to the multidimensional theory of humor by showing that not all components of humor expression can be linked to positive outcomes. Specifically, we have shown that both positive and negative humor styles do exist, and that these are differentially associated with factors of human resiliency. Individuals exhibiting either affiliative or self-enhancing humor are more likely to also yield high scores on mental toughness, thereby demonstrating greater resistance against life's adversities. In contrast, those habitually employing aggressive or self-defeating humor show reduced mental toughness, and therefore a vulnerability to stress and challenge.

Although it is possible that mental toughness dictates the humor style that one assumes, it is also feasible that the propensity to engage in different humor styles may allow for the development of greater or reduced mental toughness. Future studies could fruitfully examine this issue of causality to clarify the direction of influence. Moreover, given previous findings of cultural differences in behavioral genetic analyses of humor styles, it would be useful to replicate the present findings on humor styles and mental toughness in samples of different nationalities.

References

- Andreou, E. (2006). Social preference, perceived popularity and social intelligence: Relations to overt and relational aggression. *School Psychology International*, 27, 339–351.
- Clough, P., Earl, K., & Sewell, D. (2001). Mental toughness: The concept and its measurement. In I. Cockerill (Ed.), *Solutions in Sport Psychology* (pp. 32–42). London: Thomson.
- Costa, P. T., & McCrae, R. R. (1992). The revised NEO personality inventory (NEO-PI-R) and the NEO five-factor inventory (NEO-FFI) professional manual. Odessa, FL: Psychological Assessment Resources.
- Cousins, N. (1979). *Anatomy of an illness*. New York: Norton.
- Dillon, K. M., Minchoff, B., & Baker, K. H. (1985). Positive emotional states and enhancement of the immune system. *International Journal of Psychiatry and Medicine*, 15, 13–18.
- Dijkstra, J. K., Lindenberg, S., Verhulst, S., Ormel, J., & Veenstra, R. (2009). The relations between popularity and aggressive, destructive, and norm-breaking behaviors: Moderating effects of athletic abilities, physical attractiveness, and prosociality. *Journal of Research on Adolescence*, 19, 401–413.
- Erickson, S. J., & Feldstein, S. W. (2007). Adolescent humor and its relationship to coping, defense strategies, psychological distress, and well-being. *Child Psychiatry & Human Development*, 37, 255–271.
- Frewen, P. A., Brinker, J., Martin, R. A., & Dozois, D. J. A. (2008). Humor styles and personality vulnerability to depression. *Humor: International Journal of Humor Research*, 21, 179–195.
- Gervais, M., & Wilson, D.S. (2005). The evolution and functions of laughter and humor: A synthetic approach. *The Quarterly Review of Biology*, 80, 395–430.
- Horsburgh, V. A., Schermer, J. A., Veselka, L., & Vernon, P. A. (2009). A behavioural genetic study of mental toughness and personality. *Personality and Individual Differences*, 46, 100–105.
- Kaiseler, M., Polman, R., & Nicholls, A. (2009). Mental toughness, stress, stress appraisal, coping and coping effectiveness in sport. *Personality and Individual Differences*, 47, 728–733.
- Kobasa, S. C. (1979). Stressful life events, personality, and health: An inquiry into hardiness. *Journal of Personality and Social Psychology*, 37, 1–11.
- Kobasa, S. C., Maddi, S. R., & Kahn, S. (1982). Hardiness and health: A prospective study. *Journal of Personality and Social Psychology*, 42, 168–177.
- Kuiper, N. A., & Martin, R. A. (1993). Humor and self-concept. *Humor: International Journal of Humor Research*, 6, 251–270.
- Kuiper, N. A., & Martin, R. A. (1998). Laughter and stress in daily life: Relation to positive and negative affect. *Motivation Emotion*, 22, 133–153.
- Kuiper, N. A., Martin, R. A., & Olinger, L. J. (1993). Coping humour, stress, and cognitive appraisals. *Canadian Journal of Behavioural Science*, 25, 81–96.
- Lefcourt, H. M. (2001). *Humor: The psychology of living buoyantly*. New York: Plenum.
- Lefcourt, H. M., & Martin, R. A. (1986). *Humor and life stress: Antidote to adversity*. New York: Springer-Verlag.
- Maddi, S. R., Brow, M., Khoshaba, D. M., & Vaitkus, M. (2006). Relationship of hardiness and religiousness to depression and anger. *Consulting Psychology Journal: Practice and Research*, 58, 148–161.
- Martin, R. A. (2001). Humor, laughter, and physical health: Methodological issues and research findings. *Psychological Bulletin*, 127, 504–519.
- Martin, R. A. (2007). *The psychology of humor: An integrative approach*. Burlington, MA: Elsevier Academic Press.

- Martin, R. A., & Dobbin, J. P. (1988). Sense of humor, hassles, and immunoglobulin A: Evidence for a stress-moderating effect of humor. *International Journal of Psychiatry in Medicine*, *18*, 93–105.
- Martin, R. A., & Lefcourt, H. M. (1983). Sense of humor as a moderator of the relation between stressors and moods. *Journal of Personality and Social Psychology*, *45*, 1313–1324.
- Martin, R. A., Puhlik-Doris, P., Larsen, G., Gray, J., & Weir, K. (2003). Individual differences in uses of humor and their relation to psychological well-being: Development of the Humor Styles Questionnaire. *Journal of Research in Personality*, *37*, 48–75.
- McGue, M., & Bouchard, T. J. (1984). Adjustment of twin data for the effects of age and sex. *Behavior Genetics*, *14*, 325–343.
- Neale, M. C., & Cardon, L. R. (1992). *Methodology for genetic studies of twins and families*. Dordrecht, The Netherlands: Kluwer Academic.
- Nezu, A. M., Nezu, C. M., & Blisset, S. E. (1988). Sense of humor as a moderator of the relation between stressful events and psychological distress: A prospective analysis. *Journal of Personality and Social Psychology*, *54*, 520–525.
- Ruch, W. (Ed.). (1998). *The sense of humor: Explorations of a personality characteristic*. New York: Mouton de Gruyter.
- Sanders, G. S., & Malkis, F. S. (1982). Type A behavior, need for control, and reactions to group participation. *Organizational Behavior & Human Performance*, *30*, 71–86.
- Sheppard, J. A., & Kashani, J. H. (1991). The relationship of hardiness, gender, and stress to health outcomes in adolescents. *Journal of Personality*, *59*, 747–768.
- Thorson, J. A., Powell, F. C., Sarmany-Schuller, I., & Hampes, W. P. (1997). Psychological health and sense of humor. *Journal of Clinical Psychology*, *53*, 605–619.
- Uchino, B. N., Cacioppo, J. T., & Kiecolt-Glaser, J. K. (1996). The relationship between social support and physiological processes: A review with emphasis on underlying mechanisms and implications for health. *Psychological Bulletin*, *119*, 488–531.
- Vernon, P. A., Martin, R. A., Schermer, J. A., Cherkas, L. F., & Spector, T. (2008a). Genetic and environmental contributions to humor styles: A replication study. *Twin Research and Human Genetics*, *11*, 44–47.
- Vernon, P. A., Martin, R. A., Schermer, J. A., Mackie, A. (2008b). A behavioral genetic investigation of humor styles and their correlations with the Big-5 personality dimensions. *Personality and Individual Differences*, *44*, 1116–1125.
- Veselka, L., Schermer, J. A., Martin, R. A., & Vernon, P. A. (2010a). Relations between humor styles and the Dark Triad traits of personality. *Personality and Individual Differences*, *48*, 772–774.
- Veselka, L., Schermer, J. A., Petrides, K. V., & Vernon, P. A. (2009). Evidence for a heritable general factor of personality in two studies. *Twin Research and Human Genetics*, *12*, 254–260.
- Wesifeld, G.E. (2006). Humor appreciation is an adaptive esthetic emotion. *Humor: International Journal of Humor Research*, *19*, 1–26.
- Zak, A., Hunton, L., Kuhn, R., & Parks, J. (1997). Effects of need for control on personal relationships. *The Journal of Social Psychology*, *127*, 671–672.