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## **Humor and Personality: Temperament and Character have Different Roles**

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### **CRedit Statement:**

**Paulo Moreira:** Conceptualization, Methodology, Funding acquisition, Project administration, Supervision, Writing – Original Draft, Writing – review & editing; **Richard Inman:** Software, Formal analysis, Data Curation, Writing – Original Draft, Writing – review & editing, Visualization. **Robert Cloninger:** Writing – review & editing

### **Abstract**

This study aimed to test how sense of humor is dependent on the complex and dynamic interactions between the emotional (temperament) and sociocognitive (character) components of personality. Specifically, we examined the relationship of temperament and/or character profiles to overall humor potential and comic style. In total, 665 adults responded to Cloninger's Temperament and Character Inventory (TCI) and the Comic Style Markers. Temperament profiles were associated with overall humor potential but not comic styles. People with positive development of all three character traits had the highest levels of fun, benevolent humor and wit. Sense of humor depended on integrated profiles of both temperament and character. We conclude that temperament energizes overall humor potential while character shapes the comic styles. This study advances research by directing focus to the causal within-person psychobiological processes that underlie sense of humor.

*Keywords:* Humor, personality, temperament, character, person-centered approach, comic style markers

## **Humor and Personality: Temperament and Character have Different Roles**

There is an evolving conceptualization of the sense of humor as a stable, yet multi-faceted and complex, component of personality (Ruch, 2008). As a trait, sense of humor is expected to contribute to a happy and fulfilled life (Allport, 1961; Freud, 1928; Maslow, 1954), is socially valued and has been considered a defining feature of positive mental health (Peterson & Seligman, 2004). The absence of sense of humor is considered nonfelicitous and a prominent feature of psychopathology (Enikolopov, Mitina, & Ivanova, 2014). Although sense of humor has often been assumed to be inherently positive, fulfilling, and healthy (Kuiper & Martin, 2010)<sup>1</sup>, researchers now typically agree that it can also be 'dark' and 'unhealthy' (Edwards & Martin, 2014; Martin, Puhlik-Doris, Larsen, Gray, & Weir, 2003).

Recent research suggests it is possible to describe differences in sense of humor quantitatively and qualitatively (Moreira & Inman, 2021; Ruch, Heintz, Platt, Wagner, & Proyer, 2018). Differences in *overall humor potential* represent quantitative differences in the extent to which individuals appreciate, interpret, produce, and use things that are amusing or funny (Hehl & Ruch, 1985; Warren, Barsky, & McGraw, 2021). In turn, differences in *style* reflect qualitative variations in sense of humor, such as differences in mood, tone or refinement (Ruch, Heintz, et al., 2018). Styles capture typical ways of thinking, feeling, and acting, and vary in terms of their characteristics

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<sup>1</sup> As described elsewhere (Ruch, 2007; Ruch, Heintz, et al., 2018) this assumption depends on which of two major terminological systems is adopted. The first, stemming from the field of philosophy, considers humor as one of multiple elements of an aesthetic category referred to as 'the comic'. As a subcomponent of the comic, humor denotes a benevolent understanding of life, the world, and people and their various imperfections and incongruities. From this perspective, sense of humor is an exclusively positive trait. The second terminological system, which is prominent in Anglo-American humor research, uses the term humor in place of the comic; that is, to serve as a neutral umbrella-term for all humor-related phenomena. In this way, sense of humor is a neutral trait that captures the totality of interpersonal variation in humor. Hence, humor can be both positive and negative. In the present article, we adopt this more contemporary nomenclature.

and level of abstraction (Ruch, Heintz, et al., 2018). Styles at higher levels of abstraction (e.g. light versus dark styles) reflect broad ranges of different behaviors. In contrast, styles at the lower levels of abstraction, capturing more elementary types and qualities of humor, reflect narrower sets of behaviors that can be trained and modified.

Recently, substantial attention has been given to classifying and describing the most narrow styles through the Comic Style Markers (CSM) framework (Heintz & Ruch, 2019; Mendiburo-Seguel & Heintz, 2019; Ruch, Heintz, et al., 2018). *Comic styles*<sup>2</sup> correspond to established categories of humor including *fun* (joking and jesting to spread good mood), *benevolent humor* (acceptance of imperfections, smiling at adversity), *wit* (skillful use of humor to generate quick punchlines), *nonsense* (intellectual play with sense and nonsense), *irony* (saying things differently than meant to exclude non-insiders), *sarcasm* (ruthless exposure to hurt others), *cynicism* (mockery to highlight weakness) and *satire* (corrective humor, using ridicule to better the world) (Ruch, Heintz, et al., 2018). These comic styles are assessed using the Comic Style Markers (CSM), which has been validated in various languages (Dionigi, Duradoni, & Vagnoli, 2021; Moreira & Inman, 2021).

Although theoretically distinct, the eight comic styles are interrelated, meaning they can be aggregated to describe higher-order styles. Exploring these interrelations has offered insights into the hierarchical structure of the sense of humor. Two studies using the CSM have shown sense of humor can be described as a hierarchical model with eight lower-order comic styles, fewer intermediate-level styles (e.g., 'light' versus 'dark' humor), and a general humor factor (Moreira & Inman, 2021; Ruch, Heintz, et al., 2018). This general humor factor accounts for the interrelations between all comic styles and is conceptually akin to overall humor potential. Critically, by using statistical

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<sup>2</sup> Like Ruch, Heintz et al. (2018), we acknowledge that 'comic styles' could alternatively be labelled 'humor styles' depending on the adopted terminological system (see Ruch, 2007). We chose to use comic styles to be faithful to the original works.

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methods such as the bifactor approach (Moreira & Inman, 2021) or ipsatized scores (Ruch, Heintz, et al., 2018) it is possible to separate the independent effects of overall humor potential versus comic style.

### **Sense of Humor and Personality**

Personality research has long considered sense humor as a topic of interest (see Ruch, 2008), with one tradition being the validation of personality constructs by assessing correlations between traits and humor constructs (Ruch, 2007). At least two meta-analyses examining studies from multiple countries have demonstrated how humor styles have fairly consistent and moderate associations with personality constructs (Mendiburo-Seguel, Páez, & Martínez-Sánchez, 2015; Plessen et al., 2020).

Studies of humor have only recently started to consider the relations between personality traits and the CSM comic styles. Most prior works have explored relationships with personality traits from the Five-Factor (Costa & McCrae, 1992) or PEN models (Eysenck & Eysenck, 1985) (e.g., Dionigi et al., 2021; Ruch, Heintz, et al., 2018; Ruch, Wagner, & Heintz, 2018). In response to this, Moreira and Inman (2021) argued there is a need to adopt alternative models of personality that can describe how the complex nonlinear interactions among psychobiological systems shape peoples' experiences and behaviors. They argued that doing so would help develop a causal explanation for intraindividual differences in sense of humor rather than simply accounting for differences between persons. In taxonomic models, traits capture stable patterns of qualities in which people differ from one another but not the psychological processes underlying those traits within persons, instead reflecting patterns of entangled interrelations between emotional and sociocognitive processes.

Consequently, such models cannot explain the experiences or actions of individuals (Cervone, 2005). A full understanding of inter- and intra-person differences in sense of humor requires describing how the emotional and rational domains of personality interact in shaping overall humor potential and comic style. Arguably, one useful tool

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for generating research toward this goal is Cloninger's Temperament and Character Inventory (TCI) (Cloninger, 2004; Cloninger, Svrakic, & Przybeck, 1993).

According to Cloninger, personality is the organization of biopsychosocial processes within the individual that enables them to shape and adapt to their changing internal and external environments. Research has shown that this depends on three distinct systems of learning and memory: associative conditioning, intentionality, and self-awareness (Cloninger, 1994, 2009; Zwir et al., 2021). These systems function in an integrated way to promote physical, mental, and social wellbeing (Cloninger, Cloninger, Zwir, & Keltikangas-Järvinen, 2019; Zwir et al., 2021). Thus, the TCI measures learning processes within individuals across contexts rather than fixed traits (although all TCI traits are meta-stable unless under conditions that promote plasticity and re-integration; Cloninger, Svrakic, & Svrakic, 1997).

The TCI measures four temperament and three character dimensions. The four temperament traits measured by the TCI have been empirically confirmed to quantify individual differences in associative conditioning and related human habitual behaviors and irrational emotional drives: *novelty-seeking* (impulsive, exploratory vs. deliberate, reserved), *harm avoidance* (fearful, pessimistic vs. risk-taking, optimistic), *reward dependence* (friendly, sentimental vs. detached, objective), and *persistence* (determined, ambitious vs. easily discouraged, underachieving). These traits are moderately heritable and stable across the life span, but can be modified by life experiences and behavioral conditioning (Cloninger, 1987; Cloninger et al., 2019; Zwir et al., 2020b). Evidence indicates that genes for these temperament dimensions code for different configurations of the four temperaments, rather than the individual dimensions (Cloninger et al., 2019).

The three TCI character dimensions capture what people make of themselves intentionally and/or creatively (Zwir et al., 2020a). *Self-directedness* measures executive functioning (subscales for being resourceful, purposeful, responsible),

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*cooperativeness* measures legislative functioning (subscales for being tolerant, helpful, empathic), and *self-transcendence* (i.e. insight in appraisal of values and theories allowing intuitive awareness of participation in something greater than oneself) measures judicial functioning. The specific configuration a person has of these three character is highly predictive of individual differences in physical, mental and social wellbeing (Cloninger & Zohar, 2011; Zvir et al., 2020a). Those with high levels of all three dimensions (the 'creative' profile) are typically insightful, creative, and humanistic (Cloninger, 2004), and are linked to longevity, prosocial behavior, fulfillment, creativity, mindfulness and other indicators of enhanced awareness (Cloninger, 2004; Zvir et al., 2019, 2021). In contrast, those with low levels of all three dimensions (the 'apathetic' profile) are the least healthy.

Longitudinal research on the TCI has considered the developmental dynamics of temperament and character as a complex adaptive system (Cloninger, 2003; Cloninger et al., 1997; Josefsson et al., 2013). More recently, functional brain imaging and genomics studies have identified three distinct networks for human learning and memory that evolved sequentially over millennia (Zvir et al., 2021) and can be specified by configurations of joint temperament-character networks (Zvir et al., 2019). Thus, the development of personality depends on complex non-linear interactions between temperament and character. Temperament influences the salience of experiences while character assigns meaning and purpose to these experiences. In turn, the appraisal of values and meaning influences salience. Put differently, character traits function to regulate temperament, while at the same time emotional states bias perception and behavior. This resulting complex adaptive system is self-organizing and produces joint temperament-character configurations that are meta-stable, but that can mature in a step-like manner (Cloninger et al., 1997). These joint temperament-character configurations capture the dynamic process of self-actualization more completely than temperament or character profiles alone and, thus, show stronger



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correlations with the three underlying genetic and brain networks for human learning and memory than either that temperament or character profiles alone (Zwir et al., 2021). In short, personality develops as a complex adaptive system toward a state of integration or coherence (Cloninger, 2004; Cloninger et al., 1997; Zwir et al., 2020b, 2020a).

## **The Present Study**

Recent evidence suggests that describing associations between sense of humor and individual personality traits cannot provide a full causal account for inter- or intra-individual differences in sense of humor. To achieve this, it is essential to understand how sense of humor depends on the integration of emotional and sociocognitive processes. Therefore, the major aim of the present study was to examine the relationship of TCI temperament and/or character configurations to sense of humor. Building on past work (Moreira & Inman, 2021; Ruch, Heintz, et al., 2018), we sought to disentangle the independent quantitative and qualitative components of sense of humor by assessing how personality configurations relate to (a) participants' mean score across comic styles and (b) ipsatized scores for each comic style (controlling for the individual differences in the general humor factor).

## **Method**

### **Participants**

A convenience sample of 767 adults completed the study. To be eligible for the final sample, participants needed < 25% missing data for the main study variables and to respond correctly to at least four of the five directed-response items included in the survey. Of the 665 participants in the final sample, 70% were women (29.6% men). The sample had an average age of 32.1 years ( $SD = 15.53$ ; range = 17 – 88). Most participants were Portuguese (95%). Most of the sample were full-time university students (44%), with the remainder either employed (35%), unemployed (4%), or retired (8%).

## **Materials and Procedure**

Participants completed the study survey independently in pen-and-paper format. All questionnaires were Portuguese versions. Participants were not compensated for their involvement.

We assessed sense of humor using the Comic Style Markers (CSM; Ruch et al., 2018). This 48-item scale comprises eight six-item subscales that capture the eight comic styles described in the introduction. Participants indicated their agreement with items on a seven-point Likert scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Internal consistency reliabilities for the eight subscales were good (omegas = .82 - .89).

We assessed personality using the 240-item Revised Temperament and Character Inventory (TCI-R) (Cloninger, 1999; Moreira et al., 2017). This scale measures the seven dimensions of Cloninger's biopsychosocial model of personality: novelty seeking (NS), harm avoidance (HA), reward dependence (RD), persistence (PS), self-directedness (SD), cooperativeness (CO), and self-transcendence (ST). Participants indicated how much they agree on a five-point Likert-type scale from 1 (*definitely false*) to 5 (*definitely true*). Internal consistency reliabilities for the seven subscales were good (omegas = .79 - .91).

## **Data Analysis**

Analyses were performed with R (version 3.6.1; R Core Team, 2019). The R code and data are available at [osf.io/m52f6/](https://osf.io/m52f6/).

## ***Personality and Sense of Humor***

We used latent profile analysis (LPA) to identify (a) temperament profiles, and then (b) character profiles. Our sample size was larger than a recommended minimum ( $N < 500$ ) to detect the correct number of latent classes (Tein, Coxe, & Cham, 2013). Temperament and character profiles were estimated using standardized mean scores for the four TCI temperament dimensions and three TCI character dimensions, respectively. To minimize the influence of extreme scores we used Winsorization to cap scores at the 5<sup>th</sup> and 95<sup>th</sup> percentiles. We identified the optimal number of profiles

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by comparing the fit of several models with increasing numbers of latent classes (Marsh, Lüdtke, Trautwein, & Morin, 2009). Model fit was assessed using AIC, BIC, Sample-Adjusted BIC, and entropy (Marsh et al., 2009). Low values for AIC, BIC, and SABIC were favored, as were high values for entropy. When there was no clear solution based on these statistical criteria, we gave preference to the model that was most theoretically consistent.

The LPA of character dimensions revealed eight profiles consistent with the eight possible combinations of high and low character scores on Self-Directedness (S or s), Cooperativeness (C or c), and Self-Transcendence (T or t). Therefore, to represent the three joint temperament-character networks we grouped participants with the four unhealthy sct, scT, sCt and sCT character profiles (emotional-unreliable network); with the healthier Sct, ScT and SCt character profiles (organized-reliable network); and the creative SCT character profile (creative-reliable) as in prior work (e.g., Moreira, Inman, & Cloninger, 2021).

After forming profiles, we performed a series of ANCOVAs to test differences in overall humor potential and comic style across the temperament profiles, character profiles, and joint temperament-character networks controlling for participant age and gender. We controlled for age (in years) and gender (dummy variable where Male = 1) in our analyses because research suggests these variables are associated with personality differences (Josefsson et al., 2013). Based on power analyses, our sample size was sufficient to detect medium effects. Overall humor potential was calculated as the grand mean across comic styles. Comic styles were analyzed as ipsative scores (comic style mean - grand mean; Ruch, Heintz, et al., 2018). Ipsative scores describe intra- rather than inter-person variability in comic styles. We used a Bonferroni corrected alpha to judge statistical significance (Streiner, 2015).

## **Results**

Table 1 shows the output of the latent profile analyses. For temperament, fit statistics favored a 4-profile solution (see Figure 1A). For character, fit statistics favored an 8-

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profile solution consistent with the eight possible combinations of high and low character scores on SD, CO and ST (see Figure 2A). Almost all possible configurations of temperament and character profiles were present in the sample (Table 2). However, Figure 3A shows that the distribution of temperament profiles across the three derived joint temperament-character networks was consistent with prior work. The most prevalent temperament profile in the emotional-unreliable network was the passionate profile (39.1%). In contrast, the most prevalent temperament profile in both the organized-reliable and creative-reliable networks was the steady temperament (at 63.4% and 61.3%, respectively). The average ages and gender distributions for all profiles and networks are available in Supplementary Materials.

Table 1.

*Fit indices for latent profile analysis based on standardized mean scores for each of the TCI temperament dimensions (Panel A), and each of the TCI character dimensions (Panel B).*

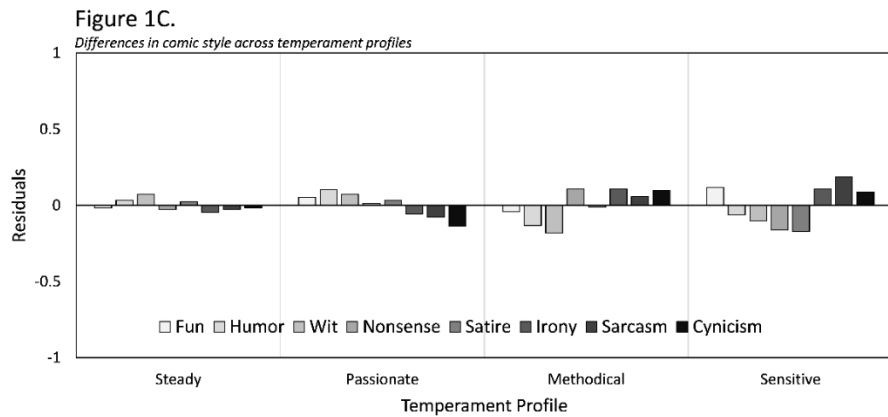
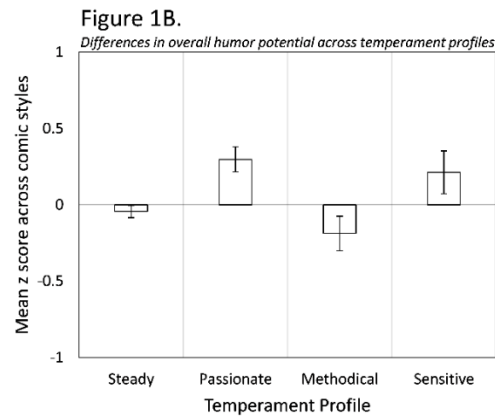
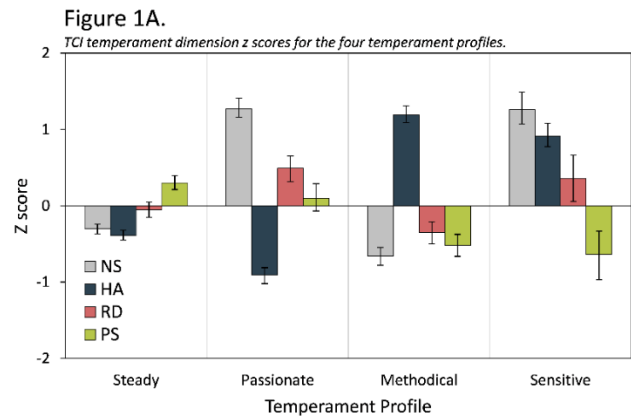
Classes	AIC	BIC	SABIC	Entropy
Panel A. LPA based on TCI temperament dimensions.				
1	6902.85	6938.85	6913.45	1.00
2	6792.91	6851.40*	9810.13	0.61
3	6776.91	6857.90	6800.75	0.51
4	6748.35*	6851.84	6778.82*	0.63*
5	6773.95	6899.95	6811.05	0.57
Panel B. LPA based on TCI character dimensions.				
1	5291.12	5318.12	5299.07	1.00
2	5140.50	5185.50	5153.45	0.64
3	5126.85	5189.84	5145.39	0.52
4	5093.76	5174.76*	5117.61	0.59
5	5091.83	5190.82	5120.97	0.55
6	5097.72	5214.72	5132.17	0.52
7	5080.49	5215.49	5120.24	0.60
8	5066.78*	5219.77	5111.82*	0.64*

*Note.* \* = lowest values for AIC, BIC, and SABIC; and highest value for Entropy.

Table 2.

*Frequencies of participants with all possible combinations of temperament and character profiles.*

Joint Temperament- Character Network	Character Profile	Temperament Profile			
		Steady	Methodical	Passionate	Sensitive
Emotional- Unreliable	Apathetic	25	18	30	15
	Disorganized	17	5	15	5
	Dependent	8	2	18	4
	Moody	19	12	28	12
Organized- Reliable	Autocratic	33	8	11	1
	Fanatical	114	26	31	11
	Organized	76	19	20	2
Creative- Reliable	Creative	49	24	7	0



*Notes.* Figure 1A. Error bars represent 95% BCa confidence intervals. NS = Novelty Seeking. HA = Harm Avoidance. RD = Reward Dependence. PS = Persistence. Figure 1B. Error bars represent standard deviations Figure 1C. Residual calculated as comic style z score – mean z score.

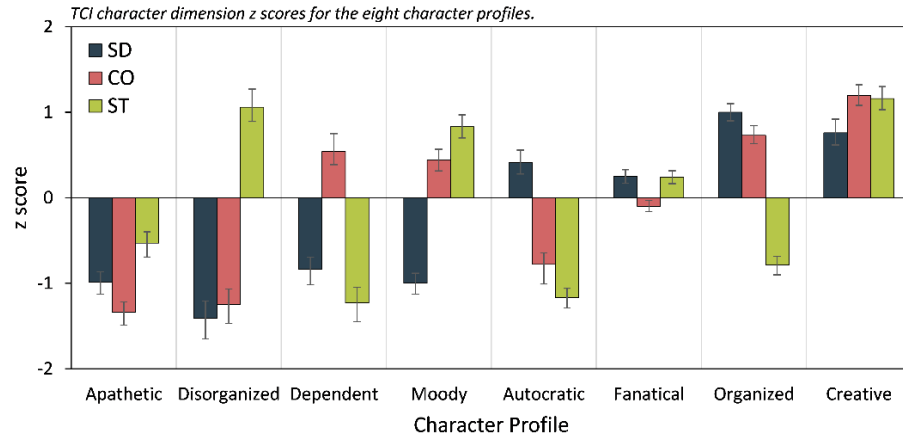
### **Temperament Profiles and Sense of Humor**

The temperament profiles differed significantly in overall humor potential,  $F(3, 657) = 8.29$ ,  $p < .001$ ,  $\omega_p^2 = .03$ , 90% CI [.01, .05] (see Figure 1B). Tukey comparisons showed people with a passionate profile had significantly higher overall humor potential than those with a steady or methodical profile (Table 3). Additionally, those with a sensitive profile had significantly higher overall humor potential than those with a methodical profile.

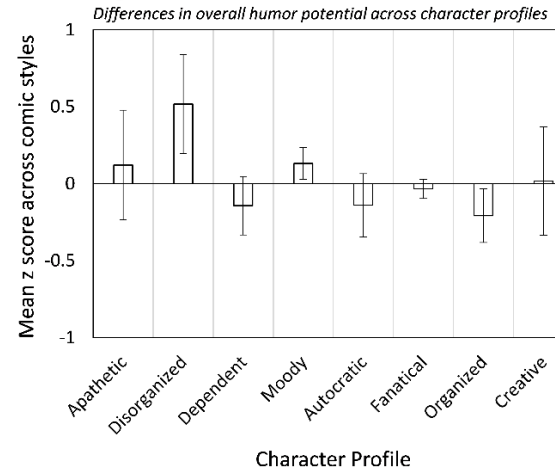
In contrast, the temperament profiles did not appear to differ meaningfully in comic style (see Figure 1C). The analyses of ipsative scores shown in Table 3 supported this observation. Temperament profiles only differed significantly in wit,  $F(3, 657) = 8.34$ ,  $p < .001$ ,  $\omega_p^2 = .03$ , 90% CI [.01, .05]. Tukey comparisons showed people with a methodical or sensitive temperament, both characterized by high HA and low PS, had lower wit than those with a steady temperament. People with a methodical temperament had lower wit than those with a passionate temperament.



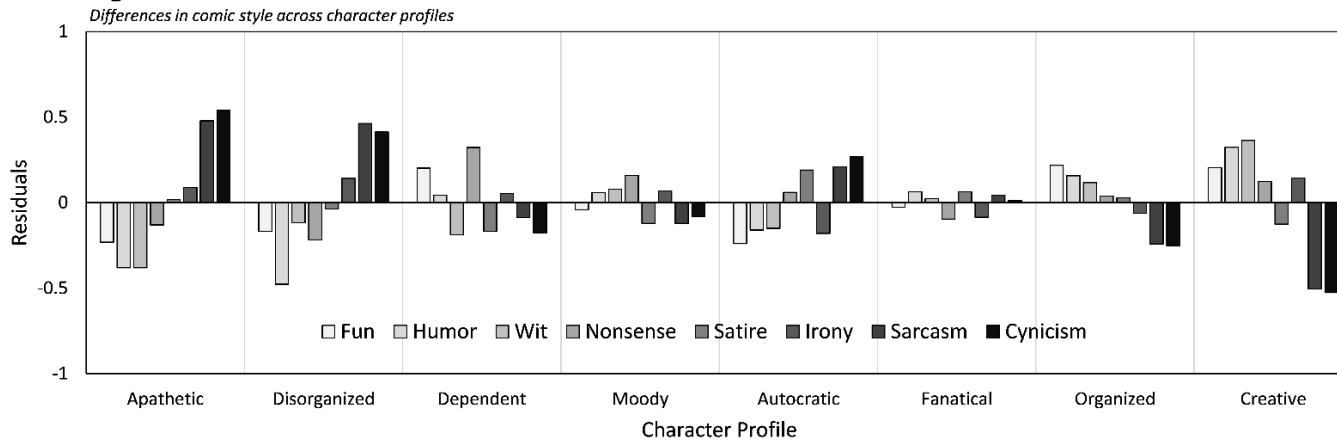
**Figure 2A.**



**Figure 2B.**



**Figure 2C.**



*Notes.* Figure 2A. Error bars represent 95% BCa confidence intervals. SD = Self-Directedness. CO = Cooperativeness. ST = Self-Transcendence. Figure 2B. Error bars represent standard deviations Figure 2C. Residual calculated as comic style z score –mean z score.

Table 3.

*Summary of ANCOVA outputs testing differences between temperament profiles in terms of (a) ipsatized comic style scores and (b) standardized mean score across comic styles, controlling for participant age and gender.*

	ANOVA			Tukey
	<i>F</i>	<i>p</i>	$\omega_p^2$	
Fun	1.65	.177	.00 [.00, .01]	
Benevolent Humor	3.62	.013	.01 [.00, .03]	
Wit	8.34	<.001	.03 [.01, .05]	Steady > Methodical Passionate > Methodical
Nonsense	2.13	.095	.00 [.00, .01]	
Satire	0.69	.558	.00 [.00, .00]	
Irony	1.39	.243	.00 [.00, .00]	
Sarcasm	3.63	.013	.01 [.00, .03]	
Cynicism	4.11	.007	.01 [.00, .03]	
Overall Humor Potential	8.29	<.001	.03 [.01, .05]	Passionate > Methodical Passionate > Steady Sensitive > Methodical

*Note.* To correct for multiplicity, we used a Bonferroni corrected alpha (.05/9 = .005).

### Character Profiles and Sense of Humor

The character profiles differed significantly in overall humor potential,  $F(7, 653) = 5.28, p < .001, \omega_p^2 = .04, 90\% \text{ CI } [.01, .06]$ , but this effect was largely driven by the high levels recorded for the disorganized profile (see Figure 2B).

The character profiles also differed significantly in terms of most comic styles (Figure 2C). This included sarcasm,  $F(7, 653) = 22.55, p < .001, \omega_p^2 = .19, 90\% \text{ CI } [.14, .22]$ , cynicism,  $F(7, 653) = 22.64, p < .001, \omega_p^2 = .19, 90\% \text{ CI } [.14, .22]$ , benevolent humor,  $F(7, 653) = 14.19, p < .001, \omega_p^2 = .12, 90\% \text{ CI } [.08, .15]$ , wit,  $F(7, 653) = 12.42, p < .001, \omega_p^2 = .11, 90\% \text{ CI } [.07, .14]$ , fun,  $F(7, 653) = 7.16, p < .001, \omega_p^2 = .06, 90\% \text{ CI } [.03, .08]$ , and nonsense,  $F(7, 653) = 3.57, p < .001, \omega_p^2 = .03, 90\% \text{ CI } [.00, .04]$ .

By comparing character profiles differing in only one character dimension (e.g., apathetic [sct] vs. autocratic [Sct]) we tested the non-linear influences of character

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dimensions on overall humor potential and comic style (see Table 4). We found that CO was consistently associated with lower sarcasm and cynicism, and higher benevolent humor. Additionally, SD was associated with lower sarcasm and cynicism, and higher wit and benevolent humor when ST was high.

Table 4.

*Summary of ANCOVA outputs testing differences among character profiles in terms of (a) ipsatized comic style scores and (b) standardized mean score across comic styles, controlling for participant age and gender.*

ANOVA				
	<i>F</i>	<i>p</i>	$\omega_p^2$	Tukey <sup>a</sup>
Fun	7.16	< .001	.06 [.03, .08]	<i>Cooperativeness</i> Sct < ScT
Benevolent Humor	14.19	< .001	.12 [.08, .15]	<i>Self-Directedness</i> scT < ScT <i>Cooperativeness</i> sct < sCt scT < sCT Sct < SCT
Wit	12.42	< .001	.11 [.07, .14]	<i>Self-Directedness</i> sCT < SCT <i>Cooperativeness</i> ScT < SCT
Nonsense	3.57	<.001	.03 [.00, .04]	<i>Cooperativeness</i> sct < sCt
Satire	1.09	.368	.00 [.00, .00]	
Irony	1.54	.150	.00 [.00, .01]	
Sarcasm	22.55	< .001	.19 [.14, .22]	<i>Self-Directedness</i> scT > ScT sCT > SCT <i>Cooperativeness</i> sct > sCt scT > sCT Sct > SCT ScT > SCT
Cynicism	22.64	< .001	.19 [.14, .22]	<i>Self-Directedness</i> scT > ScT sCT > SCT <i>Cooperativeness</i> sct > sCt scT > sCT Sct > SCT ScT > SCT
Overall Humor Potential	5.28	<.001	.04 [.01, .06]	<i>Self-Directedness</i> scT > ScT <i>Self-Transcendence</i> sct < scT

*Note.* To correct for multiplicity, we used a Bonferroni corrected alpha (.05/9 = .005).

<sup>a</sup>To evaluate nonlinear influence of each character dimension, we only present outcome of comparisons where other two dimensions remain constant.

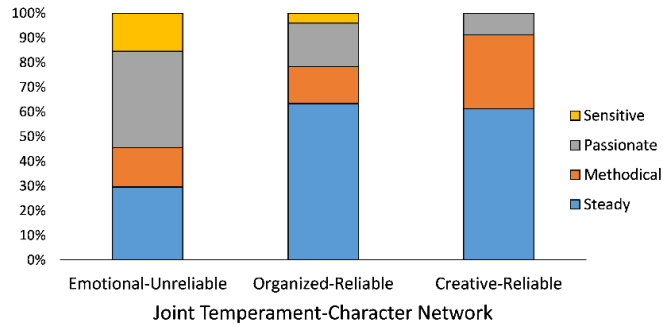
### **Joint Temperament-Character Networks and Sense of Humor**

The joint temperament-character networks differed in overall humor potential,  $F(2, 658) = 3.95$ ,  $p = .020$ ,  $\omega_p^2 = .01$ , 90% CI [.00, .02], although the effect size implied the difference was not practically significant (Ferguson, 2009) (see Figure 3C and Table 5).

The networks differed significantly in terms of fun,  $F(2, 658) = 9.12$ ,  $p < .001$ ,  $\omega_p^2 = .02$ , 90% CI [.01, .04], wit,  $F(2, 658) = 26.68$ ,  $p < .001$ ,  $\omega_p^2 = .07$ , 90% CI [.04, .10], benevolent humor,  $F(2, 658) = 26.81$ ,  $p < .001$ ,  $\omega_p^2 = .07$ , 90% CI [.04, .10], sarcasm,  $F(2, 658) = 37.44$ ,  $p < .001$ ,  $\omega_p^2 = .10$ , 90% CI [.06, .14], and cynicism,  $F(2, 658) = 38.67$ ,  $p < .001$ ,  $\omega_p^2 = .10$ , 90% CI [.07, .14]. The networks also differed weakly in irony,  $F(2, 658) = 4.30$ ,  $p = .014$ ,  $\omega_p^2 = .01$ , 90% CI [.00, .02].

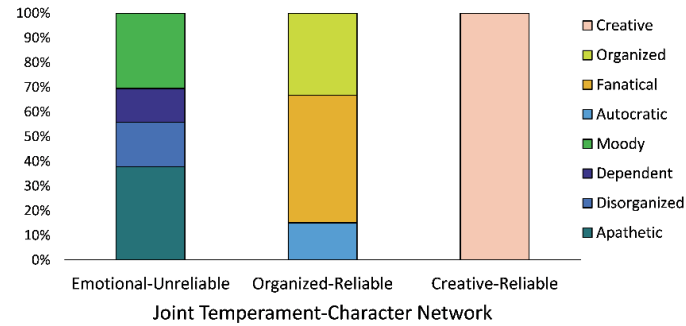
**Figure 3A.**

*Composition of joint temperament-character networks in terms of temperament profiles.*



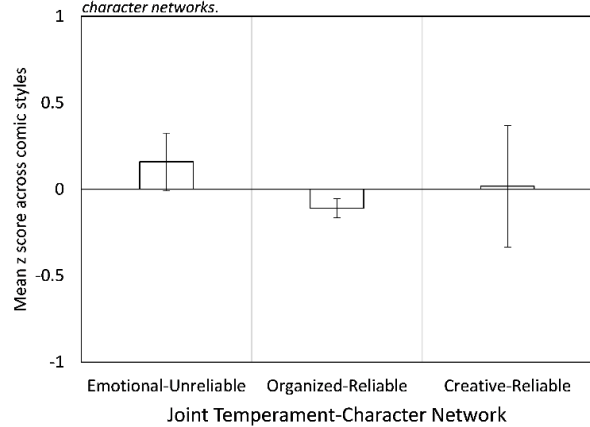
**Figure 3B.**

*Composition of joint temperament-character networks in terms of character profiles.*



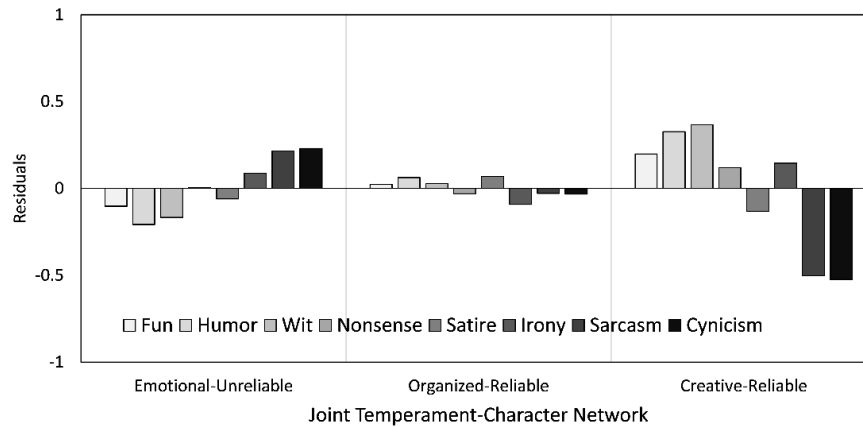
**Figure 3C.**

*Differences in overall humor potential for the three joint temperament-character networks.*



**Figure 3D.**

*Differences in comic style for the three joint temperament-character networks.*



Notes. Figure 3C. Error bars represent 95% BCa confidence intervals. Figure 3D. Residual calculated as comic style z score – mean z score.

Table 5.

*Summary of ANCOVA outputs testing effect of joint temperament-character network on (a) ipsatized comic style scores and (b) standardized mean score across comic styles, controlling for participant age and gender.*

	ANOVA			Tukey <sup>a</sup>
	<i>F</i>	<i>p</i>	$\omega_p^2$	
Fun	9.12	<.001	.02 [.01, .04]	Emotional-Unreliable < Organized-Reliable Emotional-Unreliable < Creative-Reliable
Benevolent Humor	26.81	<.001	.07 [.04, .10]	Emotional-Unreliable < Organized-Reliable Emotional-Unreliable < Creative-Reliable Organized-Reliable < Creative-Reliable
Wit	26.68	<.001	.07 [.04, .10]	Emotional-Unreliable < Organized-Reliable Emotional-Unreliable < Creative-Reliable Organized-Reliable < Creative-Reliable
Nonsense	1.70	.184	.00 [.00, .01]	
Satire	2.02	.134	.00 [.00, .01]	
Irony	4.30	.014	.00 [.00, .02]	
Sarcasm	37.44	<.001	.10 [.06, .14]	Emotional-Unreliable > Organized-Reliable Emotional-Unreliable > Creative-Reliable Organized-Reliable > Creative-Reliable
Cynicism	38.37	<.001	.10 [.07, .14]	Emotional-Unreliable > Organized-Reliable Emotional-Unreliable > Creative-Reliable Organized-Reliable > Creative-Reliable
Overall Humor Potential	3.95	.020	.01 [.00, .02]	

*Note.* To correct for multiplicity, we used a Bonferroni corrected alpha (.05/9 = .005).

## Discussion

A first finding of the study was that the four temperament profiles differed in overall humor potential but largely not in comic style (see Table 6 for a summary of findings). Specifically, participants with a sensitive or passionate profile (high NS and high RD) had higher overall humor potential compared to those with a methodical or steady profile (low NS and low RD). The combination of high NS and high RD, implying a tendency for reward hypersensitivity (particularly social rewards) and behavioral activation, has been linked to traits such as self-indulgence and egocentrism (Cloninger, 1987). These results suggest that the interaction between NS, associated with curiosity about new and unusual things and the neurotransmitter dopamine, and RD, associated with seeking social approval and with the neurotransmitter noradrenaline, is critical for understanding the temperamental underpinnings of the sense of humor. Specifically, high NS and RD, in terms of biochemical components (dopamine and noradrenaline, respectively) and psychological processes (such as flexibility, curiosity, and reward hypersensitivity), capture affective states of high energy and arousal (Yik, Russell, & Steiger, 2011). As described in models of affect (Posner, Russell, & Peterson, 2005; Russell, 2003), such states mobilize complex neurophysiological mechanisms and circuitries in interactions that stimulate and mobilize basic processes (attention, perception, reasoning) as features of complex information-processing (Phelps, 2006). Consequently, our results imply that neuropsychological activation by NS and RD (associated with higher flexibility in the attention systems, and increased speed of reasoning) 'energizes' overall humor potential.



Table 6.

*Summary of study findings.*

	Temperament Profiles	Character Profiles	Joint Temperament-Character Networks
Quantitative Component of Sense of Humor			
Overall humor potential	✓	x <sup>b</sup>	x
Qualitative Component of Sense of Humor (Comic Styles)			
Fun	x	✓	✓ Highest for creative-reliable
Benevolent Humor	x	✓	✓ Highest for creative-reliable
Wit	✓ <sup>a</sup>	✓	✓ Highest for creative-reliable
Nonsense	x	✓	x
Satire	x	x	x
Irony	x	x	x
Sarcasm	x	✓	✓ Highest for emotional-unreliable
Cynicism	x	✓	✓ Highest for emotional-unreliable

*Notes.* ✓ = meaningful significant differences observed. x no meaningful significant differences observed.

<sup>a</sup>Significant differences in wit between temperament profiles may be because CSM wit items also capture psychobiological processes linked to persistence temperament (see discussion).

<sup>b</sup>Most character profiles did not differ substantially in overall humor potential although the disorganized profile showed elevated levels.

The study also showed that temperament profiles were mostly unrelated to comic style, the sole exception being wit. Specifically, the Steady and Passionate profiles had higher wit than the Methodical profile. CSM wit items include phrases such as “I quickly read situations...”, “I have a sharp wit and intellect...”, and “I can make relationships between disconnected ideas or thoughts...”. Such phrases are suggestive of processes that are typical of the psychobiological features of PS temperament. Indeed, Moreira and Inman (2021) found that a wit specific factor in a CSM bifactor model had a significant and moderate association with PS ( $r = .44$ ). PS, which refers to the neuromodulator of the functional connectivity between sub-cortical and pre-frontal cortex, is linked to individual differences in cognitive processing and associated brain circuitry (Gardini, Cloninger, & Venneri, 2009; Gusnard et al., 2003). Specifically, PS reflects how people connect different systems and sources of information (sub-cortical and pre-frontal) and their correspondent information content (emotional associative

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conditioning and cognitive representational information). This finding raises the interesting question of whether CSM wit items reflect a distinct stylistic quality of humor or broader cognitive processes related to persistence temperament (or individuals' appraisals and representations about these processes, such as beliefs about having a 'sharp wit and intellect'; see Mischel & Shoda, 1995). Consequently, future research should seek to clarify whether wit (the skillful use of humor) reflects a distinct comic style or more basic information processing dynamics that underlie humor.

A second finding was that people with different character profiles showed remarkable variability in comic style (excluding satire and irony). In contrast, the character profiles generally did not differ in overall humor potential. Such variability in comic style was most evident when comparing the least healthy (low development in all three character dimensions) to healthiest (highly developed in all three character dimensions) personalities. Specifically, the least healthy character profiles showed a trend for dark styles (particularly sarcasm and cynicism) over light styles, while the healthiest personality showed a trend for light styles over dark styles. However, it was clear that these were nonlinear effects. Fortunately, it was possible to evaluate the nonlinear influences of each character dimension by comparing profiles where the two character dimensions not under evaluation remain constant. This revealed several findings. Firstly, CO was associated with lower sarcasm and cynicism. It was also associated with increased benevolent humor, apart from when SD and ST were already high. For other comparisons, increased CO also elevated other light styles including nonsense (apathetic vs. dependent), fun (autocratic vs. organized), and wit (fanatical vs. creative). These findings align with an understanding of CO as a person's social tolerance, empathy, and helpfulness. SD was also linked to a shift away from sarcasm and cynicism, although only significantly when ST was high. Finally, contrasting with the positive linear correlations between ST and several comic styles (wit, benevolent, humor) identified by Moreira and Inman (2021), the nonlinear

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comparisons indicated that ST was unrelated to comic style. In sum, these results suggest that what one intentionally makes of themselves as an individual with goals and values, and as part of a group or society, is critical for understanding their comic style.

According to Cloninger's model, temperament and character configurations exert influence on each other in complex yet systematic ways. Recent works with large samples has identified three phenotypic networks corresponding to people with poorly regulated temperament, those with well-developed self-regulatory abilities, and those with developed self-regulation and self-awareness (Zwir et al., 2019). People in this final network have a coherent personality in which a person's habits, goal, and values are well-integrated (Zwir et al., 2019) and have been found to be the most virtuous (Moreira et al., 2021b). Comparing these networks, we found no statistically meaningful differences in overall humor potential. However, we found that these networks shaped the quality of one's sense of humor; that is, their comic style. People with poorly regulated temperaments tended to have style of humor characterized by sarcasm and cynicism over fun, benevolent humor and wit. This personality network has been linked in past research to increased maladaptive functioning and illbeing (Moreira, Inman, & Cloninger, 2020, 2021a; Zwir et al., 2019), including greater risk of cardiovascular disease, negative emotions, and cynical distrust (Rosenström et al., 2012). In contrast, people who had a steady or methodical temperament with well-developed character dimensions (a creative profile) tended to have style of humor characterized strongly by fun, benevolent humor and wit. These findings indicate that a light humor style (which in Positive Psychology literature has been conceptualized as a 'character strength'; Peterson & Seligman, 2004) emerges when an individual has a well-integrated personality, which is also linked to the flourishing of virtues and other aspects of well-being (Cloninger, 2004; Moreira et al., 2021b).

Our findings concerning joint temperament-character network are surprisingly consistent with classic discussions on humor and personality. For example, Allport (1931, 1961) distinguished between a mature sense of humor (the ability to laugh at things we love, including the self, while still loving them) as a cardinal characteristic of a healthy and mature/tolerant personality (defined by an integrated sense of self, warm relations with others and insight) and a cruder, more aggressive, albeit more common, sense of humor linked to more immature personalities (Martin, 1998). Similarly, Maslow (1954) considered a sense of humor as a characteristic of psychological health, particularly those he described as being “self-actualizing” (Kuiper & Martin, 1998), and Freud (1928) considered the significance of a benign sense of humor for mental health.

### **Limitations**

Our study, as most, had some limitations. First, our choice to use a convenience sample limits the generalizability and threatens external validity of our findings. Second, the sole use of self-reported measures meant that participants' scores on study measures may have been influenced by unwanted biases (although see Chan, 2009). Finally, the cross-sectional design of the study precludes strong inferences about causality. However, it is worth noting that the TCI has been validated extensively by clinical interviews, longitudinal studies of development, and neurobehavioral, neurogenetic and evolutionary studies that support causal inferences about the functioning of TCI traits and profiles.

### **Conclusion**

Our results imply that the emotional component of personality (temperament) energizes humor production and appreciation. In turn, sociocognitive organizations that shape how a person regulates their emotional reactions to be congruent with their goals and values, and to function as a member of a group or society, appear to influence the specific expression of humor in terms of comic style. We found that light

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comic styles were elevated in people whose temperament and character traits were well integrated compared to those whose temperament was weakly regulated by their character traits (who in turn showed a darker style of humor defined by sarcasm and cynicism). Consequently, a dark style of humor may be an expression of an unhealthy personality, which reflects emotional reactivity and less coherent sociocognitive processes.

We conclude that individual differences in sense of humor are shaped by the interaction between emotional and sociocognitive processes, with emotional dimensions (temperament) energizing sense of humor and sociocognitive processes (character) shaping comic styles. Our study advances a tradition of research on humor that has thus far largely focused on describing associations between sense of humor and specific personality traits (such as the Big Five traits; see Mendiburo-Seguel et al., 2015). Specifically, this study (a) directs research toward trying to identify the causal forces underpinning sense of humor, (b) draws specific attention to the psychobiological processes underlying sense of humor, and (c) promotes a study of humor considering people as unified wholes; that is, adopting a model of personality that can describe within-person dynamics (Benet-Martínez et al., 2015).

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