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Tendency to laugh is a stable trait: findings from a round-robin conversation study

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People often laugh during conversation. Who is more responsible for the laughter, the person laughing or their partner for eliciting it? We used a round-robin design where participants ($N = 66$) engaged in 10 different conversations with 10 same-gender strangers and counted the instances of laughter for each person in each conversation. After each conversation, participants rated their perceived similarity with their partner and how much they enjoyed the conversation. More than half the variability in the amount a person laughed was attributable to the person laughing—some people tend to laugh more than others. By contrast, less than 5% of the variability was attributable to the laugher's partner. We also found that the more a person laughed, the more their partners felt similar to them. Counterintuitively, laughter *negatively* predicted conversation enjoyment. These findings suggest that, in conversations between strangers, laughter may not be a straightforward signal of amusement, but rather a social tool. We did not find any personality predictors of how much a person laughs or elicits laughter. In summary, how much a person laughs in conversation appears to be a stable trait associated with being relatable, and is not necessarily reflective of enjoyment.

This article is part of the theme issue 'Cracking the laugh code: laughter through the lens of biology, psychology and neuroscience'.

1. Introduction

Laughter is a universal human behaviour [1–3] that develops even before infants can speak [4]. But the fact that laughter is a global and early developing phenomenon does not mean that everyone laughs in the same way or to the same degree. People likely vary in their tendency to laugh just as they vary along many other behavioural dimensions including how they explore information [5], empathize and recognize emotions [6], and connect socially [7]. Here we ask whether the frequency with which people laugh in conversation also comprises a stable individual difference and whether this individual difference predicts more personal (individual enjoyment) or social (perceived similarity) outcomes.

There is good reason to believe that the tendency to laugh varies from person to person and may even have genetic roots. One vivid example comes from research on identical twins, Daphne Goodship and Barbara Herbert. Separated at birth, Daphne and Barbara did not meet until they were forty but, when they did, their similarity was unmistakable. Each would burst into near-identical peals of laughter, often in mid-sentence—so much so that researchers at the Minnesota Center for Twin and Adoption Research nicknamed them 'the giggle twins' [8]. Researchers have also found that people differ in their ability to *elicit* laughter from their social partners [9,10] and

people who make others laugh tend to be higher in the traits of self-monitoring and social assertiveness [11]. ‘Gelatophiles’, or people who enjoy making others laugh, are higher in the traits of extroversion and lower in the traits of conscientiousness and neuroticism [12]. We propose that *the tendency to laugh*, may similarly comprise a stable individual difference. But why would people differ on how much they laugh? Addressing that question means addressing the question of why people laugh at all.

Intuitively, laughter signals enjoyment. Consistent with this intuition, people report enjoying laughing [13], seek out social partners who produce laughter [14–16] and try to elicit laughter from others [10,17]. Social interactions that contain laughter are enjoyed more than social interactions that do not, and this enjoyment carries over into future interactions [18]. Even hearing certain forms of laughter is known to induce positive affect [19]. Relaxed social laughter is also associated with reduced pain, suggesting it may be mediated by endorphins [20]. Recent research supports this claim: watching laughter-inducing comedy clips with close friends predicted endogenous opioid release [21].

Note, however, that all of the above examples are also social in nature. Indeed, laughter occurs almost exclusively in social contexts [22,23]: people laugh 30 times more in the presence of others versus alone [24]. This suggests that laughter may be at least as much about influencing or communicating social bonds [25,26] than it is about individual enjoyment [27,28]. Young children (31–49 months) were eight times more likely to laugh at a cartoon if they watched it with another child despite not rating it any funnier than when they were alone [29]. Laughter also occurs regularly in the absence of humour or strong positive affect [2,30–33]. Thus, how much people laugh may be better predicted by the perceived or desired kinship with others, than by one’s own personal amusement [34–36]. This hypothesis comports with evolutionary accounts of laughter as originating from play vocalizations that serve the social function of signalling mutual non-threat, ‘we are just playing’.

Here we ask whether *the tendency to laugh* and *the tendency to elicit laughter* are stable individual differences. Further, we investigate whether either tendency predicts personal enjoyment as well as perceived social alignment (similarity).

(a) The present study

In order to examine the relationship between laughter frequency, conversation enjoyment and perceived similarity, we collected dyadic conversations in a round-robin design wherein each participant engaged in 10 conversations with 10 unique partners. We used a social relations model to quantify how much a participant’s laughter in each conversation is determined by (a) their stable laughter tendency, (b) attributes of their partner, and (c) unique properties of the conversation. This repeated-measures design allowed us to test whether the amount of laughter in a particular conversation predicts enjoyment or whether people who tend to laugh more also tend to enjoy conversation more. Participants talked with same-gender partners as mixed-gender dynamics are known to have complex effects on laughter frequency [30,37,38]. Finally, given known personality attributes associated with humour (e.g. higher self-monitoring and social assertiveness—[11]) and the desire to make others laugh (e.g. higher extroversion, lower conscientiousness and

neuroticism—[12]), we explored whether personality traits predict the tendency to laugh or elicit laughter in others.

2. Method

(a) Participants and design

Undergraduate students ($n = 66$; 33 female and 33 male) participated in exchange for course credit. Participants completed pre-study questionnaires which included items from a battery of psychological assessments. This study was approved by the Dartmouth Committee for the Protection of Human Subjects.

The study was conducted using a round-robin design, with six groups consisting of 11 same-gender participants. Three of the round-robin groups were all women and three were all men. Of the participants who reported their race, 39 identified as White, 14 as Asian/Asian-American, three as Latinx/Hispanic, one as Native American and three as bi- or multi-racial. The average age of participants was 19 years (s.d. = 1.28 years). Five reported being non-native English speakers.

All participants were scheduled to complete 10 conversation sessions, one with each of the other 10 members of their round-robin group. On a scale from 0 to 100, in which 0 indicated not knowing their partner at all prior to the study session and 100 indicated knowing their partner extremely well, the mean response was 8.98 (s.d. = 20.55). Thus, the vast majority of these conversations were between strangers.

In each session, two participants entered the laboratory and were instructed to talk freely about anything that they liked for 10 min. The participants were informed that their conversation would be audio and video recorded. Participants sat across from each other at a table with microphones that recorded audio. A single webcam recording to Quicktime on a computer captured a video of both participants in profile. Following the conversation, participants each entered a private room where they completed a post-study Qualtrics survey assessing their feelings about their partner and the conversation (see electronic supplementary material, Appendix for the full survey). Participants never had more than three conversations in one day. Eight sessions were not completed due to medical, scheduling or technical issues. In total, 322 conversation sessions were collected.

(b) Laughter

The conversations were transcribed by a professional transcription service, Scribie. These transcripts indicated instances of laughter from each participant. A team of research assistants compared each transcript to each video and ensured that all instances of visible and/or audible laughter were included in the transcripts. Our laughter variable of interest was the number of times each participant laughed in each conversation. We counted the number of laughter bouts, which were defined as a single continuous vocalization (e.g. a continuous string of ‘ha ha ha’s). Note that our variable of interest is the *number* of laugh bouts per person, not the *duration* of their laughter, due to the way laughter was coded in the transcripts. Each conversation therefore generated two laughter counts: one for each of the two conversation partners. Participants laughed an average of 8.88 times (s.d. = 7.53, min. = 0, max. = 45) per conversation.

(i) Social relations models

We used the social relations modelling approach [39] to estimate how much variability in the amount of laughter was due to stable trait-like properties of the participants versus their responses to their partners in a particular conversation (figure 1). Social relations analyses are a type of random-effects

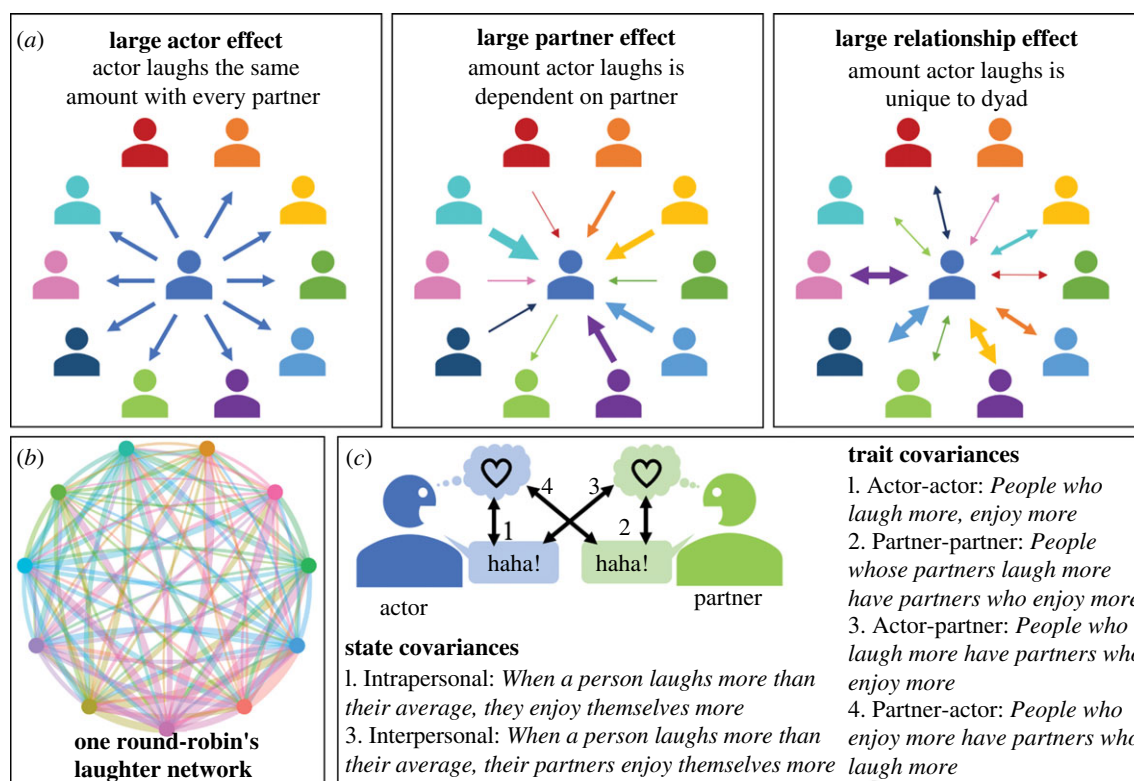


Figure 1. Possible variance and covariance estimates from social relations analysis. (a) Variances estimated in a univariate round-robin social relations model illustrated as three hypothetical results. Arrow widths represent the amount of laughter produced by the actor (the centre figure), and arrow directions indicate the source(s) of influence on amount of laughter. (b) Laughter data from one of six round-robin groups. Each person is represented as a node and the amount that they laughed with each partner is represented by the width of the line connecting them to the partner. The magenta node at 6 o'clock nicely demonstrates the large observed actor effect, as the lines originating from that node are all a similar width. (c) Covariances estimated in a bivariate round-robin social relations model, in which two variables (here, amount of laughter and enjoyment) are measured for each participant. The model separates all possible state and trait relationships between the two variables.

ANOVA where each level of a variable is an individual participant [40]. Unlike the traditional use of ANOVA, in which researchers care about the mean fixed effect of a variable, a social relations analysis is used to quantify and partition variance in the variable. The *actor effect* is an estimate of how much the tendency to laugh comprises a stable individual difference—i.e. whether some people are more likely to laugh than others (figure 1a). The *partner effect* is an estimate of how much participants' tendency to laugh is determined by their partner's attributes—i.e. whether some people make their *partners* laugh more than others. The *relationship effect* captures the remaining variance including whether *particular dyads* laugh a lot. However, because we have only one conversation per dyad it is not possible to separate relationship effects from measurement error.

The social relations modelling approach can also decompose the different forms of covariance between two variables in a round-robin design [41]. Six covariances between two variables are estimated in a bivariate round-robin model (figure 1c). Two covariances, intrapersonal and interpersonal covariance, capture the within-person relationships between the two variables. The remaining four covariance estimates capture bivariate relationships between people's stable tendencies.

(c) Conversation and partner ratings

We focused on the eight post-conversation survey items (table 1) that involved global evaluations of the conversation and their partner and excluded items that were less clearly evaluative (e.g. 'my study partner seemed to be an extroverted person'; see electronic supplementary material, Appendix for the complete list of items, including those not analysed here). The eight questions used in the present work were positively correlated

($0.35 < r < 0.87$) so we conducted an exploratory factor analysis using varimax rotation to reduce the number of conversation outcome variables. We retained the factors with eigenvalues greater than 1, resulting in a two-factor solution. The first factor explained 41% of the variance and the second explained 30%. We labelled the factors based on the highest-loading item for each, naming factor 1 'enjoyment' and factor 2 'similarity' (see the rest of the factor loadings in table 1).

(d) Personality measures

The personality variables came from a mass survey distributed each academic term to subject pool participants and varied from term to term. For the purposes of the present work, we decided *a priori* to explore responses to the following personality surveys as correlates of laughter: Big Five Aspect Scale (BFAS; [43]), Interpersonal Reactivity Index, Revised UCLA Loneliness Scale [44], Need to Belong scale [45], Sensitivity to Rejection scale [46], State-Trait Anxiety Inventory [47] and State Self-Esteem Scale [48]. See electronic supplementary material, Appendix for a more detailed description of these scales as well as a complete list of all measures collected.

Across all participants and all personality variables of interest, 15.95% of the personality data had missing values. To impute the missing data we used the mice package [49]. We used the available personality data, plus participants' averages and standard deviations for all partner and conversation rating items, to inform the imputations (including the conversation rating variables not used in the factor analysis; see electronic supplementary material, Appendix). Note that we did not include laughter variables as inputs to the missing data imputation since they are the outcome variables of interest. Because the

Table 1. Partner evaluation factor loadings and means.

item	factor 1 enjoyment	factor 2 similarity	mean (s.d.)
'How well did this conversation 'flow'?' (0 = not at all, 100 = very)	0.82	0.35	73.25 (21.23)
'How much did you enjoy the conversation you had with your study partner?' (0 = not at all, 100 = very much)	0.88	0.41	72.55 (20.95)
'How much would you like to be friends with your study partner? (0 = not at all, 100 = very much)	0.64	0.62	66.81 (24.13)
'My study partner was a fun person to talk to' (0 = strongly disagree, 100 = strongly agree)	0.75	0.45	68.20 (20.86)
'I felt comfortable having a conversation with my study partner' (0 = strongly disagree, 100 = strongly agree)	0.70	0.35	73.86 (19.87)
'My study partner and I seemed to have a lot in common' (0 = strongly disagree, 100 = strongly agree)	0.40	0.70	53.18 (22.07)
'My study partner and I seemed to have similar personalities' (0 = strongly disagree, 100 = strongly agree) ^a	0.32	0.86	53.12 (21.65)
'How well do you think you know your study partner now?' (0 = not well at all, 100 = extremely well)	0.31	0.38	42.42 (20.62)

^aThis item is not as clearly evaluative as the others, but given people's preferences for partners who are similar to them, we included it [42].

imputation process is stochastic, with different random seeds producing different estimates for the missing data, we imputed five complete datasets. We then conducted regression analyses (described in Results) over all five datasets and pooled their estimates [50].

3. Results

We first used the social relations model to estimate the within-person stability and variability in how much a person laughed and elicited laughter from others. Next, we asked how the amount a person laughed covaried with their own and partners' self-reported enjoyment and perceived interpersonal similarity. We then explored personality predictors of laughter frequency across conversations. All analyses were conducted using R [51] and all data, analysis code and output are available online (data and code: <https://osf.io/tfxa7/>; output: <https://rpubs.com/adriennewood/822529>).

(a) Is laughter in conversation a stable individual difference?

We estimated the actor, partner and relationship effects using the TripleR library in R [41]. The RR (round-robin) function uses Lashley and Bond's [40] approach for computing *p*-values. The actor effect, partner effect, relationship effect and covariances were calculated first for each of the six round-robin groups (each *n* = 11). The variance of each estimate was then calculated as a function of group size, the number of groups and the mean of the group-level estimate. The result is a *p*-value that indicates whether a variance estimate is different from zero. See Lashley and Bond [40] for the formulae as well as a demonstration of the robustness of this approach.

The actor effect explained 56.46% of the variance in laughter, $t = 5.206$, $p < 0.001$, providing strong evidence that the tendency to laugh is a stable individual difference. By contrast, the partner effect explained only 4.11% of the variance, $t = 2.888$, $p = 0.003$, suggesting that laughter is not well-predicted by the tendency to *elicit* laughter. The relationship effect comprised 39.44% of the variance, $t = 14.486$, $p < 0.001$, though due to the nature of the social relations model, we cannot know whether this variance is caused by unique attributes of conversations—two people 'clicking', for instance—or measurement error.

One well-known determinant of how much a person laughs is how much their partner laughs [33], and here, this effect is reflected in the positive relationship covariance, $r = 0.381$, $t = 5.15$, $p < 0.001$. People laugh more than their average if they are with a partner who is laughing more than their average. Finally, the covariance between actor and partner's laughter variance was positive, $r = 0.784$, $t = 3.65$, $p = 0.001$, suggesting that people who tend to laugh more also tend to elicit more laughter from their partners (see all model estimates in table 2).

(b) Does laughter predict conversational enjoyment and perceived similarity?

In the bivariate social relations model with laughter and enjoyment, only the actor-actor covariance term was significant, and negatively so (table 2). This indicates that the people who generally enjoyed conversations more also laughed *less* than average (figure 2a). In the model with laughter and perceived similarity, the partner-partner covariance term was significant and positive. This indicates that people whom others generally perceive as similar to them are also the ones who elicit more laughter (figure 2d). The significant intrapersonal relationship covariance term further

Table 2. Univariate and bivariate social relations model estimates.

	s.e.	t	p
laughter univariate model			
actor variance	0.565	5.206	<0.001
partner variance	0.041	2.888	0.003
relationship variance	0.394	14.486	<0.001
actor-partner covariance	0.784	3.650	0.001
relationship covariance	0.381	5.515	<0.001
laughter ~ enjoyment model			
actor-actor covariance	−0.311	−2.021	0.024
partner-partner covariance	0.179	0.774	0.221
actor-partner covariance	0.108	0.698	0.244
partner-actor covariance	0.005	0.027	0.489
intrapersonal relationship covariance	0.058	1.257	0.107
interpersonal relationship covariance	0.038	0.823	0.207
laughter ~ perceived similarity model			
actor-actor covariance	0.136	0.880	0.191
partner-partner covariance	0.440	1.953	0.028
actor-partner covariance	0.252	1.656	0.051
partner-actor covariance	0.071	0.330	0.371
intrapersonal relationship covariance	0.091	1.922	0.030
interpersonal relationship covariance	0.074	1.558	0.062

indicates that, at the dyad level, when people feel similar to a partner, they laugh more than their average frequency.

(c) What are the personality correlates of trait laughter tendencies?

We next investigated whether participants' average amount of laughter was related to personality variables and gender. For each participant, we computed the average number of laughs they (a) produced and (b) elicited across all 10 conversations. We then ran two multiple regression analyses with all of the personality and gender variables predicting each of these two dependent variables (laughter produced and elicited). Because the laughter production variable was positively skewed with a floor at 0 (being derived from count data) we used a generalized linear model with a gamma distribution and a log link. The laughter elicited variable was normally distributed so we used general linear regression.¹ Both models were fit to the five imputed datasets and the results were pooled using the mice function in R [49]

The combined personality variables explained an average of 18.76% (min. = 15.98%, max. = 33.56%) of the variance in average amount of laughter *produced* (calculated as

((null deviance−residual deviance)/null deviance) × 100). Because a general linear model was used to predict average amount of laughter elicited (a normally distributed variable), R^2 was used as a goodness-of-fit metric. The combined personality variables explained an average of 34.40% of the variance in average amount of laughter *elicited* (mean R^2 = 0.344, min. = 0.103, max. = 0.588).

Next, we examined each personality measure's relationship to laughter by examining the pooled estimates for individual personality predictors and gender in both models. We used a Bonferroni correction to control our type I error rate. We did not find any evidence that any of these variables significantly related to laughter individually (see electronic supplementary material, Appendix). However, it is likely that these between-subject analyses were underpowered in this dataset. A power analysis determined that the minimum detectable effect for a single predictor was f^2 = 0.18 (with 80% power and alpha = 0.05, [52]). This is equivalent to R^2 = 0.16, meaning an individual predictor would need to explain nearly as much variance as all predictors combined.

4. Discussion

The present work examined stability and variability in how much people laugh during conversations with strangers. To disentangle the various contributors to laughter variability, we used a round-robin study design in which each person had 10 different conversations with 10 different partners. In these encounters, more than half of the variability in how much people laughed had nothing to do with the unique attributes of the conversation or their partner and instead comprised a stable individual difference.

By contrast to previous findings linking laughter with enjoyment (e.g. [18]), we found that people who tended to laugh *more* actually reported enjoying their conversations *less*. This between-person finding reveals the importance of separating within- and between-person relationships between laughter and variables of interest. If our participants only had a single conversation, we might have concluded that enjoyable conversations with strangers involve less laughter. However, such a within-person effect was notably not supported by our data. Instead, the negative relationship was between two tendencies centred in the people themselves: the tendency to laugh (across conversation partners) and the tendency to enjoy conversation (across conversations). Our study also differs from previous work in that we quantify *actual* laughter as opposed to asking participants to recall how much laughter occurred in their interactions. Retrospective reports may be biased towards remembering prototypical high-arousal enjoyment laughter [32] rather than other forms of laughter [30]. In this study, we counted all instances of laughter regardless of laughter type.

We also found that people who laugh more are perceived as more similar by their partners. This finding complements prior experimental evidence that being made to laugh with a stranger increases feelings of closeness [53] and that similarity is a marker of friendship [54]. Future research is needed to adjudicate the direction of causality—whether laughter increases perceived similarity, whether perceived similarity increases laughter, or whether both are mutually reinforcing.

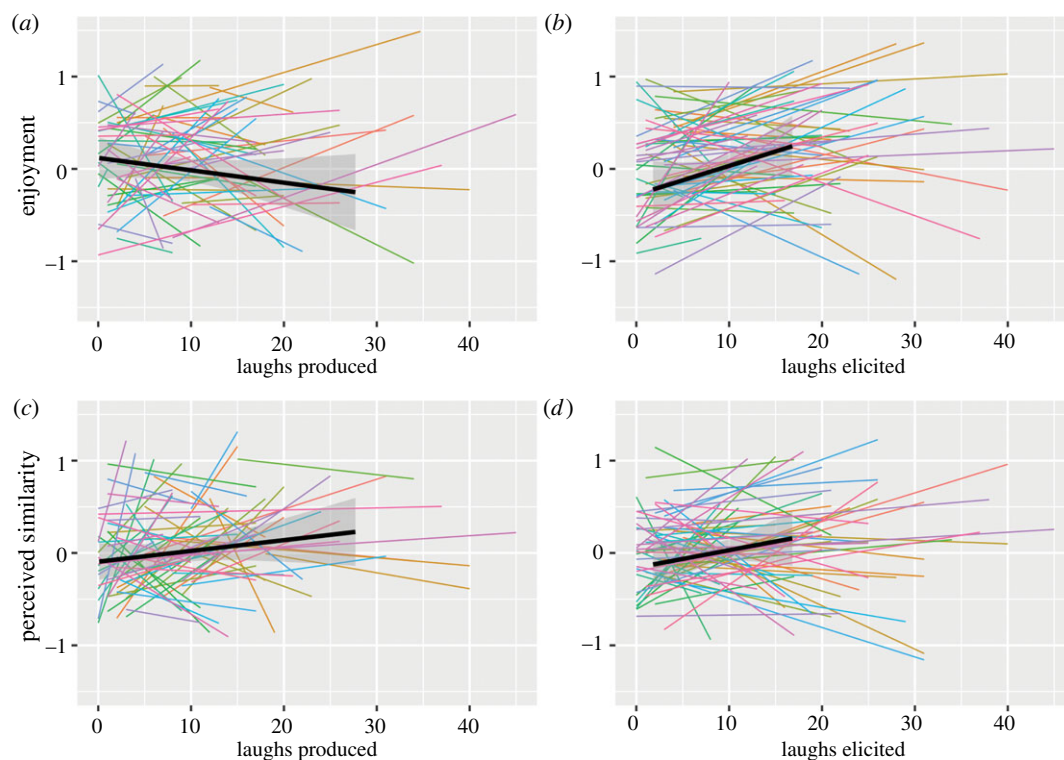


Figure 2. Within- and between-person correlates of laughter. Black regression lines represent the between-person effects—in other words, the covariance between average number of laughs and average conversation evaluations. The other lines represent each participant's relationship between laughter (either produced or elicited) and rating (either enjoyment or perceived similarity). (a) The between-person covariance between average laughs produced and average enjoyment was negative (actor-actor covariance). (b) Amount of laughter elicited was not related to enjoyment. (c) The only within-person relationship that was significant (indicated by majority of lines angled upward) was between laughs produced and perceived similarity (intrapersonal relationship covariance). (d) The between-person covariance between how much laughter a person tended to elicit and how similar their partners tended to perceive them (partner-partner covariance).

A multiple regression analysis that included a suite of personality measures suggested that personality explained 19% of between-person variability in the tendency to produce laughter and 34% of between-person variability in the tendency to elicit laughter. However, none of the individual personality measures were significant predictors of laughing on their own. Results from a power analysis indicated that our sample size only allowed us to detect relatively large effects of personality on laughter, given our sample size. Although our dataset includes a large number of *conversations*, it does not include a large number of *participants*. This is because each participant has multiple conversations, permitting the use of the social relations model but limiting the power to detect individual-level effects. Thus, although our results suggest that personality does not have a large effect on the tendencies to laugh and elicit laughter, we cannot rule out more modest effects of personality on laughter.

Our findings underscore two important methods considerations for studies on social interaction. First, we demonstrate the power of round-robin designs [39,55]. Without observing the same people across multiple social contexts, it is impossible to deduce whether a given conversational outcome is driven by one partner versus another, or particular to their interaction. Second, we demonstrate the importance of measuring different aspects of people's subjective experiences during social interaction. For example, we found that laughter had opposite relationships with enjoyment and perceived similarity despite both measures indicating conversational 'success'.

Our study has several limitations that would be beneficial to address with future research. First, our primary

independent variable was simply *counts* (frequency) of laughter. Frequency is only one of the many features of laughter that may relate to conversation enjoyment and perceived similarity. Growing evidence suggests that laughter is not monolithic, but that there are different kinds that communicate different things, depending on the context and the acoustic properties of the laugh [32]. Some laughter is rewarding to produce and perceive [19] and has the acoustic markers of high physiological arousal, such as glottal whistles and sub-harmonics [56,57]. Other types of laughter have different acoustic properties and social functions [33]. Second, knowing whether participants are laughing alone or at the same time as their partner is an important consideration. Co-laughing is correlated with positive relationship outcomes [58]. People prefer others who laugh with them compared to those who do not [59] and friends co-laugh more frequently than strangers [60]. In a study of spontaneous laughter in romantic couples [61], the amount of co-laughter positively predicted several measures of relationship well-being. There are, however, boundary conditions on what co-laughter can tell us: in one study, co-laughter on blind dates did not predict self-reported attraction [62]. Quantifying additional aspects of laughter—duration, acoustic qualities, co-laughter and others—can help more precisely elucidate the relationship between laughter and conversation outcomes. For example, if most of the laughter produced in conversations with strangers serves affiliative, tension-reducing goals, it may explain the somewhat counterintuitive finding that people who laughed more, enjoyed conversations less. Affiliative laughter might be deployed more when conversations are not going well in an attempt to decrease discomfort.

It will also be important to examine laughter across different populations and conversational contexts. The dyads in this study were all same-gender and mostly white, unacquainted undergraduates at an elite US institution. Any one of these factors might limit the generalizability of our findings. We also suspect that the negative relationship observed here between enjoyment and laughter may be specific to the conversational context of unacquainted dyads. Interactions with familiar partners are generally more enjoyable [7] and laughter-filled [63], suggesting that laughter in these contexts is less about tension reduction and more reflective of genuine merriment (e.g. [58]). Although the laughter observed between strangers in the present study predicted the perception of similarity, it is likely that this laughter differs in important ways from the laughter of people who share a more established social bond. Comparing the same people across conversations differing in familiarity, status and other contexts is important to reveal whether the tendency to laugh—which was notably stable in the present study—is also stable within and across other relationship types.

In summary, how much people laugh when talking to a stranger appears to be a stable trait that says more about them than it does about their partner or the conversation itself. Although the tendency to laugh with strangers was associated with enjoying the conversations less, it also predicted perceived similarity with the conversation partner. This is consistent with the idea that the tendency to laugh with strangers is less reflective of enjoyment than facilitating social alignment.

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Ethics. This study was approved by the Dartmouth Institutional Review Board (approval no. 29842).

Data accessibility. All data used in the analyses are available online at <https://osf.io/tfxa7/>.

Authors' contributions. A.W.: conceptualization, formal analysis, visualization, writing—original draft; E.T.: conceptualization, data curation, methodology, project administration, writing—review and editing; J.M.: formal analysis, writing—original draft; F.S.: formal analysis, validation; T.W.: conceptualization, methodology, resources, supervision, writing—review and editing.

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Endnote

¹The large actor effect in our round-robin analyses helps us explain why the average number of laughs produced is skewed while the average number of laughs *elicited* is not. Because laughter in the present study is such a stable behavioural tendency, if a person only laughs one time in a conversation, they will likely only laugh one or two times in their other conversations. Their average laughs produced will therefore be close to zero. However, even such an extreme non-laughter (or an extreme laughter) is going to encounter both laughers and non-laughers over the course of the study, so their average laughs elicited will approach the sample's average laughter. Thus average laughs elicited is normally distributed even if the raw data is not.

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