Forgiveness Takes Place on an Attitudinal Continuum from Hostility to Friendliness:
Toward a Closer Union of Forgiveness Theory and Measurement

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ABSTRACT

Researchers commonly conceptualize forgiveness as a rich complex of psychological changes involving attitudes, emotions, and behaviors. Psychometric work with the measures developed to capture this conceptual richness, however, often points to a simpler picture of the psychological dimensions in which forgiveness takes place. In an effort to better unite forgiveness theory and measurement, we evaluate several psychometric models for common measures of forgiveness. In doing so, we study people from the United States and Japan to understand forgiveness in both non-close and close relationships. In addition, we assess the predictive utility of these models for several behavioral outcomes that traditionally have been linked to forgiveness motives. Finally, we employ the methods of item response theory, which place person abilities and item responses on the same metric and thus help us draw psychological inferences from the ordering of item difficulties. Our results highlight models based on correlated factors models and bifactor (S-1) models. The bifactor (S-1) model evinced particular utility: Its general factor consistently predicts variation in relevant criterion measures, including four different experimental economic games (when played with a transgressor), and also suffuses a second self-report measure of forgiveness. Moreover, the general factor of the bifactor (S-1) model identifies a single psychological dimension that runs from hostility to friendliness while also pointing to other sources of variance that may be conceived of as method factors. Taken together, these results suggest that forgiveness can be usefully conceptualized as prosocial change along a single attitudinal continuum that ranges from hostility to friendliness.

Keywords: forgiveness, TRIM, bifactor model, cross-cultural, reconciliation

INTRODUCTION

Because conflict is unavoidable, forgiveness is crucial for maintaining social relationships: People must be able to move past negative motivations if they are to retain their valuable social partners. Researchers have made considerable progress in mapping the information-processing mechanisms that regulate forgiveness (Fehr, Gelfand, & Nag, 2010). Noteworthy advances include: (i) an emerging consensus on a basic definition of interpersonal forgiveness as “prosocial change toward a perceived transgressor” (McCullough, Pargament, & Thoresen, 2001; p. 9); (ii) the development of theoretical models of forgiveness that expand upon this basic definition by specifying a conceptually rich and multidimensional set of psychological changes that can involve attitudes, emotions, behaviors, and physiology (Worthington et al., 2015); and (iii) the validation of multiple instruments for measuring forgiveness as conceptualized in these more complex models (see Worthington et al., 2015).

Despite these advances, the research literature provides multiple hints of possible misfit between *a priori* conceptions of forgiveness and how measurement tools are used to model those conceptions. For example, McCullough and colleagues have depicted forgiveness as a suite of motivational changes whereby a victim becomes less vengeful, less avoidant, and more benevolent toward a transgressor (McCullough, Fincham, & Tsang, 2003; McCullough & Hoyt, 2002). To measure this three-factor conception of forgiveness, they developed the Transgression-Related Interpersonal Motivations Inventory (TRIM-18; McCullough, Root, & Cohen, 2006). In some of the work using this questionnaire, researchers have scored the TRIM Inventory as if it reflects the operation of three distinct motivations--revenge, avoidance, and

benevolence (Bono, McCullough, & Root, 2008; Carmody, Gordon, & Differences, 2011; Tsang, McCullough, & Fincham, 2006). Despite the supposed conceptual distinctions among these constructs, the subscales used to measure them are often highly intercorrelated (e.g., McCullough, Root, & Cohen, 2006). In other studies, researchers have used versions of the TRIM Inventory to model two distinct motivations—the motivation to seek revenge and a bipolar motivation that ranges from avoidance to benevolence (e.g., McCullough, Bono, & Root, 2007; McCullough et al., 2006). In still other work, researchers have simply summed the items on the TRIM Inventory as if forgiveness reflects change across a single attitudinal continuum that runs from hostility to friendliness (Harper et al., 2014; McCullough, Luna, Berry, Tabak, & Bono, 2010; McCullough, Pedersen, Tabak, & Carter, 2014; Ohtsubo, Yamaura, & Yagi, 2015; Tabak, McCullough, Luna, Bono, & Berry, 2012; Worthington et al., 2015). Which of these models best reflects the psychological dimension or dimensions along which forgiveness takes place? Are there really multiple distinct motivational changes underlying forgiveness, or does forgiveness instead mostly reflect change across a single underlying psychological dimension?

Other researchers have faced similar challenges in matching their conceptions of forgiveness with the empirical realities of their measures. Subkoviak et al. (1995), for example, defined forgiveness as the confluence of positive and negative cognitive, affective, and behavioral components in which “a person overcomes resentment toward an offender, but does not deny him/herself the moral right to such resentment. The forgiver tries to have a new stance of benevolence, compassion, and even love toward the offender, even though the latter has no moral right to such a response” (p. 642).

Subkoviak et al. sought to measure this notion of forgiveness, in all of its conceptual richness, with the 60-item Enright Forgiveness Inventory, which was designed with six distinct subscales to reflect both positive and negative manifestations of cognition, affect, and behavior. Despite the conceptual depth of their six-dimensional model of forgiveness, a single summary score based on all 60 items behaves in every way (e.g., internal consistency, test-retest reliability, correlation with other measures) similarly to the six individual subscales (see also Orathinkal, Vansteenwegen, Enright, & Stroobants, 2007), suggesting that the conceptual distinctions between cognitive, affective, and behavioral components are not borne out empirically.

Similarly, Rye et al. (2001) developed their self-report measure of forgiveness ("The Forgiveness Scale") with the goal of differentiating between the presence of positive emotions and the absence of negative emotions toward the offender. Despite their efforts to separate these concepts, the two subscales exhibited a strong positive correlation, achieved similar internal consistency and test-retest reliabilities, and evinced similar correlations with a variety of validation targets—all of which suggests that the subscales may reflect a single latent continuum rather than two meaningfully different dimensions of forgiveness.

Further, Worthington, Hook, and Utsey (2007), and more recently, Davis et al. (2015) developed self-report measures to distinguish between decisional forgiveness (which they define as a behavioral intention to act less negatively and more positively toward an offender) and emotional forgiveness (which they define as a process in which positive other-oriented emotions replace unforgiving emotions). This subtle psychological distinction may not be optimally captured by the two scales, however,

inasmuch as their correlation has ranged from .31 to .72 in previous research. Their correlations with a variety of other measures tend to be comparable as well (Hook et al., 2013; Kurniati, Worthington, Kristi Poerwandari, Ginanjar, & Dwiwardani, 2017; Sandage et al., 2015; Scherer et al., 2012; Watkins et al., 2011; Worthington et al., 2007), and measures of these two constructs correlate as highly with other self-report measures of forgiveness as those other measures correlate with each other (e.g., the TRIM-18 and the Rye Forgiveness Scale; Davis et al., 2015; Recoder, Gámiz, Worthington, Davis, & Fernández-Capo, 2019; Sandage et al., 2015; Worthington et al., 2007).

These four sets of results suggest that the underlying attitudinal dimensions upon which forgiveness takes place may be conceptually leaner than researchers have posited. Indeed, they all suggest that participants' scores on the sort of items that are often used on these scales (e.g., "I'll make him or her pay"; "I'd keep as much distance between us as possible"; "Even though his/her act hurt me, I still have good will for him/her") are caused at least in part by a general factor that runs from negative (i.e., malevolent) evaluative reactions to the transgressor to positive evaluative reactions to the transgressor, perhaps along with additional factors that influence scores on some of the items (e.g., items related to revenge) but not others (e.g., items related to benevolence). Since a hostility-friendliness dimension appears to suffuse interpersonal behavior in general (as exemplified in the interpersonal circumplex model of interpersonal behavior; Gurtman, 2009), it would hardly be surprising to find that forgiveness also reflected movement away from a hostile attitude regarding a transgressor and movement toward a friendly or conciliatory attitude. To the extent that

item responses are caused both by such a general factor and extraneous influences (e.g., residual motives, method effects), efforts to measure forgiveness may be impeded by psychometric models that cannot easily separate these two types of variance.

There would be additional theoretical benefit from the ability to more precisely model forgiveness as a single latent continuum that runs from negative to positive evaluations toward a transgressor. The prospect that the questionnaire items that researchers use to measure forgiveness (which often involve self-reports of affects, cognitions, and behaviors toward a transgressor) can be summarized with a single general factor would suggest that forgiveness could reasonably be described as a positive change in one's attitude toward an offender (inasmuch as recent formal accounts depict attitudes as global evaluative reactions toward an attitude object that incorporate beliefs, feelings, and behaviors; Dalege et al., 2016). This could prove to be a theoretical boon for forgiveness research because so much is already known about the nature of attitudes and attitude change (Albarracin & Shavitt, 2018; Bohnet & Dickel, 2011). Locating the concept of forgiveness within the broader conceptions of attitudes and attitude change could speed future progress substantially.

In hopes of better uniting forgiveness theory and measurement, here we systematically evaluated several modeling options for the TRIM Inventory in hopes of determining the model that best depicts the underlying psychological dimension (or dimensions) in which forgiveness takes place. To do so, we compared congeneric models used in the existing literature (one-factor, two-factor, and three-factor models) to models that depict forgiveness primarily as psychological change in a single attitudinal dimension (e.g., hostile-friendly), along with additional dimensions that might influence

scores on some of the items but not others. These latter models, which depict a general factor and additional item-specific content (or method) factors, can be specified using variants of the bifactor modeling approach (Eid, Geiser, Koch, & Heene, 2017).

Bifactor Modeling: General and Specific Motives Underlying Forgiveness

Recent interest in measuring general factors that span specific factors has spurred the development of different so-called G-factor models (Eid et al., 2017), such as bifactor models (Holzinger & Swineford, 1937). In a traditional bifactor model, a general factor explains item responses across all domains while residual factors explain item responses on their specified domains (Reise, 2012). However, the traditional model is inappropriate when applied to typical survey methods, which has motivated the development of alternative bifactor modeling approaches (Eid et al., 2017). One of the models Eid et al. (2017) proposed is referred to as the bifactor (S-1), in which the general factor loads on all indicators (as in the traditional bifactor model), but specific (S) factors are modeled for all but one of the specific domains (hence, S-1) while the non-modeled specific domain defines the scale of the general factor. When applying this model to the TRIM Inventory, one might specify a model in which a hostility-friendliness factor explains item responses across domains of avoidance, benevolence, and revenge, and two other latent variables account for residual variance in two of the three domains, leaving one domain to set the scale for the general factor.

To apply the bifactor (S-1) model to the TRIM Inventory, one must first select one domain to represent the general factor. We suggest that avoidance is an appropriate reference domain because forgiveness is most consistently conceptualized as a reduction in people's motives to avoid their transgressors; in other words, forgiveness is

206 conciliatory movement away from hostility toward friendliness in which victims give their
207 transgressors a subsequent opportunity to be good social partners. The use of
208 avoidance as a reference domain is also supported by research indicating that
209 approach and avoidance motives are distinct, and that benevolence and revenge
210 motives are both approach-oriented, thereby making them share something important
211 that is not shared by avoidance (Elliot & Thrash, 2002). See Figure 1 for our depiction of
212 the bifactor (S-1) model as applied to the TRIM Inventory.

213 *Does the TRIM Inventory Predict Behavior toward the Transgressor?*

214 In addition to the frustrations associated with obtaining a good fit between
215 forgiveness theory and measurement, researchers who study forgiveness often lament
216 the fact that self-report measures of forgiveness are rarely validated against behavioral
217 measures to demonstrate that they reflect interpersonally consequential psychological
218 processes (Worthington et al., 2015; for notable exceptions, see Carlisle et al., 2012;
219 Dorn, Hook, Davis, Van Tongeren, & Worthington, 2014; Exline, Baumeister, Bushman,
220 Campbell, & Finkel, 2004). Without such validation efforts, researchers face an uphill
221 battle in arguing that the motivational changes they seek to measure via self-report
222 reflect changes in how the victim treats the offender. On an evolutionary view, the
223 function of forgiveness is to motivate behaviors that signal one's willingness to re-
224 establish cooperative relations contingent on amended behavior on the transgressor's
225 part (Billingsley, Burnette, & McCullough, in press; McCullough, Kurzban, & Tabak,
226 2013). If this specification of the function of forgiveness is correct, and a self-report
227 measure of forgiveness is valid, then scores on that measure should correlate with
228 behavioral measures that might signal a willingness to return to cooperative relations.

Over the past several decades, researchers have developed a variety of standardized experimental economic games that are generally taken to reflect people's willingness to trust others, to share with others, to cooperate with others in the pursuit of mutual benefit, to uphold the principle of fairness, and to retaliate (or, conversely, to refrain from retaliating). Games such as the iterated prisoner's dilemma (Axelrod, 1980), the Dictator Game (Forsythe, Horowitz, Savin, & Sefton, 1994), the Trust Game (Berg, Dickhaut, & McCabe, 1995), and the pay-to-punish game (Fehr & Fischbacher, 2004) all appear to reflect the operation of a domain-general phenotype that creates covariances among these games (McAuliffe, Forster, Pedersen, & McCullough, 2018; Peysakhovich, Nowak, & Rand, 2014). Furthermore, the shared variance among these games is reflected in peer-judgments of people's altruistic and trusting tendencies (McAuliffe et al., 2018), suggesting that people's scores on these laboratory-based behavioral measures reflect a friendly or prosocial approach to real-life interpersonal interactions. These behavioral economic measures therefore present unique opportunities to assess whether forgiveness as measured by self-report is associated with affiliative interpersonal behavior toward the person whom one has forgiven.

The Present Project

Here, we sought to assess the relative fit and predictive utility of alternative psychometric models, including the bifactor (S-1) model and more traditional congeneric factor models used for the TRIM-18 in the past. Further, we tested these models using a new form of the TRIM-18 designed for non-close others (TRIM-NCO), as well as the original TRIM-18. To pursue our research questions in relations between non-close others, we implemented an experimental paradigm across three settings: Online

participants from the United States, laboratory participants from the United States, and online participants from Japan. Across the three experiments, we also evaluated whether the factors we specified predicted people's scores on an iterated prisoner's dilemma game, a dictator game, a trust game, and a pay-to-punish game. To then test the generalizability of our modeling approaches to different relationship types and measurement scales, we conducted two non-experimental studies in two settings: Online participants from the United States and laboratory participants from Japan. In these survey studies, we used a self-report measure of forgiveness as the criterion by which to assess each model's predictive utility, and we evaluated the bifactor (S-1) model's ability to account for scores on other measures of forgiveness as well (Hook, Worthington, & Utsey, 2009; Hook, Worthington, Utsey, Davis, & Burnette, 2012).

STUDIES 1-3: AN EXPERIMENTAL EVALUATION

Data from the first three studies shared virtually the same protocol, with only a few differences. Because most measures we report here are identical across studies, we present the methods and results for these studies concurrently, which allows us to conserve space by avoiding unnecessary repetition of our procedures and results, while also enabling us to easily compare results across these studies.

STUDIES 1–3: METHOD

We preregistered the protocol for the first study on the Open Science Framework (<https://osf.io/pm7fi/>); however, none of the research questions or analyses reported here were part of the preregistration plan.

Participants

Study 1. Participants were 1,887¹ workers from Amazon's Mechanical Turk (MTurk; 49% female; Age: $M = 33.93$ years; $SD = 10.48$). All participants entered the experiment with the expectation of a guaranteed \$3.50 and a bonus that would depend on their decisions in the study; in reality, everyone received a \$6.50 bonus and therefore earned \$10 for participating. Descriptive statistics are available in the supplemental information.

Study 2. To maximize statistical power and access to participants in Study 2, we recruited participants from two sources. First, we recruited 342 students from the undergraduate psychology participant pool at a small university in the southeastern United States ($Mean\ Age = 19.41$ years; $SD = 4.77$; data on participants' sex were not collected). Although participants initially believed they could earn up to \$10 (implying the possibility of earning less), all received the full \$10 in addition to partial course credit for participating. Second, we recruited 79 participants from the surrounding community via e-mail and Craigslist. Participants from the community sample were on average 36.20 ($SD = 11.95$) years old. All community participants received a \$20 show-up fee. In addition, these participants initially believed they would earn a bonus up to \$11 (depending on their decisions in the study), although all community participants received the full \$11, resulting in a total of \$31 in compensation for their participation.

Study 3. We recruited 300 Japanese adults using a Japanese crowdsourcing service called Lancers, Inc (65% female; Age: $M = 36.57$; $SD = 10.12$). All participants entered the experiment with the expectation of a guaranteed 350JPY and a bonus that

¹ Although we preregistered that we would exclude suspicious participants ($N = 867$) from analyses, we included all participants because (1) the analyses reported here were not part of the preregistration plan and (2) we found that measures were invariant across levels of suspicion. Still, we report analyses with suspicious participants excluded in the supplemental information.

would depend on their decisions in the study; in reality, everyone received a 650JPY bonus and therefore earned 1000JPY for participating.

Materials and Procedures

Software Implementation and Participant Familiarization

Study 1. We programmed Study 1 using SoPHIE - the Software Platform for Human Interaction Experiments (Hendriks, 2012). SoPHIE enabled us to set up a virtual waiting room, which participants entered after consenting to participate. Participants remained in the waiting room until a second participant joined, whereupon the two actual participants were paired and given the opportunity to engage in an authentic communication task. Participants who spent seven minutes in the waiting room without being paired were dropped from the experiment, compensated \$0.70 for their time, and permitted to participate in a successive session of the experiment (our reported sample size includes only those who completed the experiment). After being paired, participants were told that the purpose of the communication task was to familiarize them with the program's chat function, which would be used throughout other tasks in the experiment. During the communication task, participants took turns sending and receiving five short messages without any guidance about what they should discuss. Therefore, when people began engaging in experimentally manipulated interactions later in the experiment (particularly during the Prisoner's Dilemma Game), they had some basis for believing the interactions were real.

Study 2. The entirety of Study 2 was conducted via computer using E-Prime 2.0 software (Psychology Software Tools, 2012). Unlike Study 1, there was no authentic computer-mediated communication between participants.

Study 3. As in Study 1, Study 3 was programmed using SoPHIE (Hendriks, 2012). Study 3 differed from Study 1 in how the chat was implemented. Initially, we did not let participants advance unless they participated in the time-constrained chat, which resulted in high levels of dropout among Japanese participants who failed to send timely messages. The difficulty communicating with strangers among Japanese participants may have been due to higher levels of shyness (Sakuragi, 2004), introversion (Lynn & Hampson, 1975), avoidance motivation (Hamamura, Meijer, Heine, Kamaya, & Hori, 2009), and/or communication apprehension (McCroskey, Gudykunst, & Nishida, 1985) compared to American participants. Therefore, instead of sending and receiving five open-ended chat messages, participants simply typed the Japanese word for ‘hello’ and received a commensurate ‘hello’ from the other participants (which was a pre-programmed response).

Overview of Experimental Tasks

In Studies 1-3, all participants engaged in an iterated Prisoner’s Dilemma Game. As described in more detail below, we used the Prisoner’s Dilemma Game to experimentally manufacture a transgression. In addition, we introduced a between-subjects message manipulation that varied post-transgression communication during the PDG. Finally, after the PDG, participants engaged in another economic game (see One-Shot Economic Games below) and completed the TRIM. In this manuscript, we present only the procedures that yielded the data analyzed here. We conducted analyses to address separate research questions in Billingsley et al. (in prep). See Table 1 for an outline of the experimental design.

Iterated Prisoner’s Dilemma Game

Following Tabak et al. (2012), we manipulated transgressions and apologies using an iterated Prisoner's Dilemma Game (PDG; called the "Decision-Making Task" in this experiment). Participants were introduced to the rules of the PDG and were told that they could earn money depending on their interactions with the other participant (a pre-programmed script, hereafter referred to as the "confederate"). If both participants cooperated, they both earned \$0.10 for the round in Study 1 (\$0.10 in Study 2; 10JPY in Study 3); if both participants defected, they both earned \$0.05 for the round in Study 1 (\$0.05 in Study 2; 5JPY in Study 3); and if one participant defected and the other cooperated, the defector earned \$0.15 in Study 1 (\$0.15 in Study 2; 15JPY in Study 3) and the cooperator earned \$0.00. The PDG lasted 29 rounds for each participant, but participants were told that they would play for an unspecified number of rounds to prevent any end-game effects. For the first 12 rounds, the confederate played a generous tit-for-tat strategy: It always cooperated on the first round and, so long as the participant cooperated on any round, the confederate cooperated on the next round. However, if the participant defected on any round, the confederate defected on the subsequent round with a 50% probability.

Because our experimental manipulations included post-transgression apologies with compensation, as a cover story we informed participants that there would be intermittent opportunities for communication throughout the decision-making task. Participants were told that they had been assigned to either a "Sender" or "Receiver" role, and that the Sender could send text, game earnings, or both. In reality, all participants were assigned to the Receiver condition, and thus were able to respond to the Sender's messages but were not able to return any money to the Sender.

364 *Transgressions*

365 Following the 12th round of the PDG, the game was interrupted by the first
366 opportunity for the confederate to send a message to the participant. As in Tabak et al.
367 (2012), participants all received the same message: “i think we should both just hit
368 cooperate” [sic]. Participants were then prompted to respond. This message was
369 designed to induce the expectation of cooperation, regardless of participants’ behavior
370 during previous rounds of play. Following the message, participants returned to the
371 PDG and the confederate defected for 7 consecutive rounds.

372 For Study 2 only, some participants were assigned to a no transgression
373 condition, in which the confederate continued a generous tit-for-tat strategy throughout
374 the entire game.

375 *Apology Manipulation*

376 Following the 7 rounds of unconditional defection, the confederate sent a new
377 message to the participant. Study 2 differed from Studies 1 and 3 in that it had a no
378 transgression condition; however, it also shared the three other message conditions
379 with the other two studies. Exact wording of each condition’s message varied slightly to
380 match the context of the study (e.g., Mturk vs laboratory study). For brevity, we report
381 only the wording for Study 2 and ask readers to consult supplemental information for
382 specific differences. In the control-message condition (as well as the no transgression
383 condition in Study 2), participants read, “this takes more concentration than i thought it
384 would. at least its more interesting than the one i did last time” [sic]. In the apologetic
385 condition, participants read the message, “sorry for doing that. i won’t do it agin. i’ll send
386 over what you lost to make it up to you.” [sic]. In the aggravating message condition,

participants read the message, “sucks for you, that’s just how you play the game. i’m just trying to make as much money as i can” [sic].

In the apology condition, but not in the other conditions, confederates sent \$1.00 of their earnings as compensation to participants (\$1.00 in Study 2; 100JPY in Study 3). We designed the offer of compensation based on evidence that apologies influence forgiveness most effectively when the transgressor incurs some cost as part of the apology (Ohtsubo et al., 2018; Ohtsubo & Watanabe, 2009; Ohtsubo et al., 2012). After the apology manipulation, the confederate unconditionally cooperated for two rounds, then resumed a generous tit-for-tat strategy for the remaining eight rounds.

Measures

Defections in the Prisoner’s Dilemma Game

To measure behaviors that should be predicted by a valid measure of forgiveness, we analyzed participants’ choices on the ten rounds of PDG behavior that followed the message manipulation. Instead of using composite scores of the number of defections, we treated each of the ten choices as an item response reflecting a latent propensity to defect, modeled as a two-parameter logistic (2PL) item response model. Such a model accounts for the possibility that item difficulties might vary across the final ten decisions of the PDG. It is possible that participants more readily defect during earlier decisions in the sequence than during later decisions, and the 2PL item response model incorporates such item-based variability into its estimate of each participant’s propensity to defect.

One-Shot Economic Games

Following the Prisoner's Dilemma Game, participants played an experimental economic game. In Study 1, we randomly assigned participants to play one of three experimental economic games (Trust Game, Dictator Game, or Pay-to-Punish Game). Each game provided an opportunity to study a different forgiveness-relevant social motivation (behavioral trust, behavioral benevolence, or behavioral revenge, respectively). In Studies 2 and 3, all participants played only the Trust Game.

In the Trust Game (TG; Berg et al., 1995), two parties are given an endowment and randomly assigned to be either Trustor or Trustee (referred to as "First Mover" and "Second Mover" in our experiment). The Trustor is able to send any amount of the endowment to the Trustee. In turn, the Trustee receives a multiple of the amount sent (here, three times the amount sent). Subsequently, the Trustee is able to return any of the money received to the Trustor. After receiving instructions for the game and playing a practice game from the perspective of both roles, participants were assigned to the role of the first mover (Trustor), ostensibly through random assignment.

In the Dictator Game (DG; Forsythe et al., 1994), two parties are given an endowment and are randomly assigned to be either the Dictator or Recipient (referred to as Decision-Maker and Recipient in our experiment). In the DG, the Dictator can send any amount of the endowment to the Recipient at a 1:1 ratio (i.e., the amount gained by the Recipient is equal to the amount paid by the Dictator). The Recipient has no opportunity to influence the Dictator's decision, and the game ends once the Dictator's decision is made. After receiving the instructions for the game and playing a practice game from the perspective of both roles, participants were assigned to the role of the Decision-Maker (Dictator), ostensibly through random assignment.

In the Pay-to-Punish Game (PTPG; Fehr & Fischbacher, 2004), two parties are given an endowment and randomly assigned to be either Decision-Maker or Recipient. The Decision-Maker is then able to spend any amount of the endowment to remove some amount from the Recipient's endowment (here, the amount removed was four times the amount paid). As in the DG, the Recipient is not given an opportunity to influence the Decision-Maker, and the Decision-Maker does not gain money by removing money from the Recipient. After receiving the instructions for the game and playing a practice game from the perspective of both roles, participants were assigned to the role of the Decision-Maker, ostensibly through random assignment.

Self-Report Measure of Forgiveness: Transgression Related Interpersonal Motivations Inventory for Non-Close Others

Immediately following participants' decisions in the second experimental economic game, they completed the 18-item Transgression-Related Interpersonal Motivations Inventory for Non-Close Others (TRIM-NCO; see Appendix A). Typically, researchers have measured forgiveness using items that assume an existing relationship between victim and transgressor, thereby limiting our ability to assess forgiveness between people who are interacting for the first time (as in a typical laboratory context). The TRIM-NCO Inventory is designed to overcome this limitation by re-wording items from the original TRIM-18 Inventory to make them sensible to people who are reporting their attitudes toward strangers.

McCullough et al. (2006) developed the TRIM-18 to measure interpersonal forgiveness in close relationships. As with the traditional TRIM-18, the TRIM-NCO

provides a self-report measure of the interpersonal motivations hypothesized to underlie forgiveness, using subscales to assess avoidant, benevolent, and vengeful inclinations.

Suspicion Probes and Debriefing

Participants responded to a series of funnel debriefing questions designed to probe whether they were suspicious of the deception in the experiment (Aronson, Carlsmith, & Ellsworth, 1990). We asked participants a series of “yes/no” questions to determine whether they had questions or comments about the experiment, followed by a free-response option if their answer indicated that they might be suspicious. Finally, we described the true nature of the experiment and explained our use of deception.

Other Measures

We also measured participants’ perceptions of the transgressor’s relationship value and exploitation risk during the PDG, which were not analyzed here. Analyses incorporating these measures appear in another manuscript (Billingsley et al., in prep).

Analyses

We conducted a variety of statistical analyses, all designed to evaluate the nature of the latent variables that are responsible for participants’ scores on the TRIM-NCO. First, we used item factor analysis to model the underlying factor structure of the TRIM-NCO in terms of both (a) a traditional, congeneric correlated-factors model that specifies participants’ scores as the result of distinct but potentially intercorrelated interpersonal motivations (i.e., avoidance, benevolence, and revenge); and (b) a bifactor (S -1) model that specifies participants’ scores as the result of a general factor that suffuses all of the items, plus additional specific factors (i.e., revenge and benevolence factors) that make certain sets of items (e.g., the revenge items) distinct from the other

items. Second, we evaluated the associations of the latent variables obtained from both modeling approaches with participants' scores in the four experimental economic games. Third, we used a variety of psychometric tests to evaluate whether the general factor from the bifactor (S-1) model (which, as we report below, appears to be the superior model from an explanatory and predictive point of view) operates in a manner consistent with unidimensionality. Fourth, we explored the conceptual meaning of the general factor from the bifactor (S-1) model by examining how items arrange themselves in terms of their difficulty and whether their arrangements conform to a hostility-friendliness continuum. Fifth, we evaluated whether participants' scores on the general factor (and its two specific factors) increase or decrease in response to post-transgression messages in a manner consistent with the hypothesis that they reflect the underlying attitudinal continuum along which forgiveness takes place.

STUDIES 1-3: RESULTS

We conducted analyses using Mplus version 7 (Muthén & Muthén, 1998-2012). Syntax and output appear in the supplemental information. We began with invariance tests to evaluate whether we were statistically licensed to analyze data from Studies 1-3 in a single set of analyses rather than in a separate set for each experiment. Subsequently, we (a) tested how well each of the psychometric models of the TRIM-NCO predicted our criterion measures, (b) assessed the adequacy of a unidimensional model of the measure, and (c) tested how constructs posited in the bifactor (S-1) model responded to experimental manipulations of apologies.

Factor Analysis of TRIM-NCO

Our first goal was to model the factor structure of the TRIM-NCO in terms of both (a) traditional, congeneric correlated-factors model that specify participants' scores as the result of three distinct but potentially intercorrelated interpersonal motivations (i.e., avoidance, benevolence, and revenge); and (b) a bifactor (S -1) model that specifies participants' scores as the result of a general factor that suffuses all of the items, plus additional specific factors (i.e., revenge and benevolence factors) that make certain sets of items (e.g., the revenge items) distinct from others. To ensure that it was meaningful to combine data from all three studies, we first tested whether a traditional correlated-factors model possessed invariance across all three data sets, with invariance being satisfied if CFI decreases by no more than .01 (Cheung & Rensvold, 2002).

After comparing one-factor, two-factor (avoidance-benevolence and revenge), and three-factor (avoidance, benevolence, and revenge) models, we found that TRIM-NCO responses from each of the three studies conformed best to the three-factor congeneric model (with three distinct but intercorrelated interpersonal motivations, versus only one or two; see supplemental information). In a grouping analysis, this configurally invariant three-factor model exhibited adequate fit, CFI = .958. We then took steps to determine whether these data passed the more stringent tests of metric and scalar invariance (see Table 2). To test for metric invariance, we conducted grouping analyses in which we specified the same three-factor structure to all three data sets and constrained factor loadings to be equal. Model fit did not decline substantially after including these constraints ($\Delta\text{CFI} = -.007$), so we proceeded to test for scalar invariance in which both the factor loadings and the item thresholds were constrained to be equal

across groups. After we included those constraints, model fit did not decline substantially ($\Delta CFI = -.010$)².

Having confirmed that the three-factor congeneric model was scalar-invariant across the three data sets, we combined the data from these three studies for subsequent analyses, beginning with analyses to compare a traditional correlated-factors model to a bifactor (S-1) model. Due to the model fit equivalence between congeneric models and bifactor (S-1) models in which the number of latent variables is the same (Geiser, Eid, & Nussbeck, 2008), we compared the performance of the three-factor congeneric model to that of a three-factor bifactor (S-1) model. We specified the bifactor (S-1) model with the subset of avoidance items as the reference domain. The general factor was scaled using the item “I would not trust him/her” (reverse-scored), the specific domain for benevolence was scaled using the item “I would have good will for him/her,” and the specific domain for revenge was identified with “I would want to seek revenge” (reverse-scored). In the interest of transparency, we also report the following analyses for each study separately in the supplemental information.

Which Factors in the Three-Factor Model Predict Economic Game Behavior?

We regressed participants’ propensities to defect in the PDG and scores in the three one-shot economic games (Study 1: TG, DG, or PTPG; Studies 2 & 3: TG) on the factors specified in the two models. Coefficients here and in Table 3 are standardized.

² In our initial analyses, we found that the item, “I hope he/she gets what he/she deserves,” which was designed as a revenge indicator, exhibited abnormally low factor loadings in all models we tested (see supplemental information for these results). Therefore, analyses from invariance tests and regression analyses reported in the main text exclude this item. Our interpretation of this result is that the item is inherently ambiguous—perhaps because a respondent can believe that a transgressor should get what he/she deserves both if he/she is believed to deserve bad and good things.

Propensity to defect in the final ten rounds of the PDG was predicted by avoidance, $b = -.321$, $se = .051$, $p < .001$, and benevolence, $b = -.146$, $se = .064$, $p = .022$, but not by revenge, $b = -.006$, $se = .039$, $p = .886$. Transfers in the TG were predicted by avoidance, $b = .163$, $se = .056$, $p = .004$, and benevolence, $b = .156$, $se = .066$, $p = .017$, but not by revenge, $b = -.079$, $se = .043$, $p = .068$. Transfers in the DG were predicted by avoidance, $b = .302$, $se = .132$, $p = .022$, but not by benevolence, $b = .063$, $se = .166$, $p = .706$, or revenge, $b = .031$, $se = .078$, $p = .695$. Finally, amounts paid to punish in the PTPG were not predicted by avoidance, $b = -.041$, $se = .137$, $p = .767$, or benevolence, $b = -.074$, $se = .174$, $p = .672$, but were predicted by revenge, $b = -.274$, $se = .077$, $p < .001$.

These results suggest that the factors from the three-factor model are useful for predicting behavioral indicators of cooperation, fairness, trust, and willingness to harm. However, traditional correlated-factors models do not assign the variance shared among the factors, which may be the most important variance for predicting external behavioral criteria. For this reason, correlated-factors models may obscure the actual predictive power of the motivational-attitudinal constructs that underlie those measures. Therefore, we compared these results to those from a bifactor (S-1) model, which we used to extract a general factor as well as specific factors for benevolence and revenge. The bifactor (S-1) approach enabled us to explicitly model the overlapping variance among the items as a substantive factor in its own right.

Which Factors from the Bifactor (S-1) Model Predict Economic Game Behavior?

In the context of the bifactor (S-1) model (see Table 3), propensity to defect in the PDG was predicted by the general factor, $b = -.415$, $se = .047$, $p < .001$, but not by

the specific factors representing benevolence, $b = -.047$, $se = .033$, $p = .149$, or revenge (reverse-scored), $b = -.016$, $se = .020$, $p = .617$. Transfers in the TG were predicted by the general factor, $b = 0.250$, $se = .027$, $p < .001$, and the benevolence specific factor, $b = .080$, $se = .039$, $p = .043$, but not by the revenge specific factor, $b = -.063$, $se = .038$, $p = .095$. Transfers in the DG were predicted by the general factor, $b = .380$, $se = .034$, $p < .001$, but not by the benevolence specific factor, $b = .021$, $se = .056$, $p = .703$, or the revenge specific factor, $b = .030$, $se = .061$, $p = .628$. Finally, amounts paid to punish in the PTPG were predicted by the general factor, $b = -.262$, $se = .052$, $p < .001$, but not by the benevolence specific factor, $b = -.052$, $se = .055$, $p = .341$, though they were also predicted by the revenge specific factor, $b = -.216$, $se = .053$, $p < .001$.

In summary, the general factor from the bifactor (S-1) model predicted participants' scores in all four experimental economic games, implying that a general attitudinal continuum underlies participants' behavior toward the transgressors who harmed them. We also found that the benevolence specific factor predicts a small amount of unique variance in participants' scores on the Trust Game and that the revenge specific factor predicts a small amount of unique variance in their scores in the Pay-to-Punish Game, though there is no principled reason why they each should predict these single criteria but not others. The PDG reflects a balance of cooperation and retaliation, so the revenge factor's failure to predict participants' scores on the PDG is puzzling. Likewise, the PDG and the Dictator Game both reflect prosocial preferences, so it is difficult to find a rationale for why the benevolence specific factor was not correlated with participants' scores in the PDG and the Dictator Game.

In light of the general factor's consistent predictive power (and the two specific factors' rather limited predictive power), we turned to further evaluating the properties of the bifactor (S-1) model. Specifically, we explored (a) whether the TRIM-NCO yields evidence of unidimensionality, (b) whether the item loadings on the general factor align themselves in a manner consistent with the idea that they reflect an attitudinal continuum that ranges from hostility to friendliness, and (c) whether the general factor and the specific factors respond to apologies in theory-consistent ways.

Do the Properties of the Bifactor (S-1) Model Support Unidimensionality?

The bifactor analyses described above yielded evidence that the scores on the TRIM-NCO can be considered to result from a general factor and two specific factors, the latter two of which may not be particularly well-interpreted as motivational dimensions in which forgiveness takes place. More stringent tests of the statistical properties of a general factor, however, are available to evaluate whether a measure is sufficiently unidimensional to be treated as such in practice (Rodriguez, Reise, & Haviland, 2016). To this end, we conducted five additional tests.

First, we found that the general factor of the bifactor model had high internal consistency, McDonald's ω Hierarchical = 0.887, whereas the benevolence and revenge specific factors yielded much lower internal consistencies (McDonald's ω Hierarchical Subscale = 0.257 and 0.638 for benevolence and revenge, respectively). Second, we examined construct reliability, which essentially correlates each factor with an optimally weighted item composite, indexed by value H . For the general, benevolence, and revenge factors, H = 0.973, 0.650, and 0.821, respectively. Hancock and Mueller (2001) recommend a criterion of H = 0.70 to indicate sufficient reliability,

which suggests that our general factor is near-perfectly specified, the benevolence factor is not well specified, and the revenge factor is reasonably well-specified.

Third, to understand whether item responses were sufficiently explained by the general factor, we examined the explained common variance (ECV), which indicated that the general factor explained 73.8% of variance in item responses; 26.2% of variance was accounted for by specific factors. Based solely upon this level of ECV by the general factor, we are within an acceptable range to propose that item responses are “unidimensional enough.” However, Rodriguez et al. (2016) note that the importance of ECV for determining unidimensionality depends upon another feature, an indicator of model structure that researchers refer to as the “percent of uncontaminated correlations” (PUC). An item’s correlation with the general factor becomes “contaminated” when that item is also used to specify a subscale: With fewer contaminated correlations, ECV becomes less important because a model without contaminated correlations *is* unidimensional and ECV is irrelevant to the decision. In our case, $PUC = 0.846$, which indicates that item correlations are largely uncontaminated in our bifactor (S-1) model and, in conjunction with $ECV = .738$, the general factor from the bifactor (S-1) model is likely a close representation of a strictly unidimensional model.

Fourth, we estimated how much bias in factor loadings would occur if researchers use a unidimensional model (that is, a one-factor model) rather than the general factor of the bifactor (S-1), on the assumption that the bifactor model correctly specifies the item response structure (Rodriguez et al., 2016). We observed an average bias of 16.1%, which is just outside Muthén, Kaplan, and Hollis’s (1987) proposed

acceptable range of 10-15%, indicating that modeling TRIM-NCO responses with a one-factor model may lead to only a small and probably tolerable amount of bias.

Finally, we correlated the general factor with the mean of all 17 items. The two measures were highly correlated, $r = .946$, $p < .001$. Unsurprisingly, the 17-item composite was also correlated with scores on each of the four experimental economic games (see supplemental information). Jointly, these results suggest that item scores on the TRIM-NCO can be treated in practice as if they were generated by a single unidimensional factor.

Is the General Factor a Continuum from Hostility to Friendliness?

To better describe the motivational-attitudinal character of the general factor, we examined the ordering of the items' difficulty levels on the general factor. In item response models for binary items, item thresholds (i.e., "difficulty parameters") provide the factor score (i.e., "ability level") under which people are equally likely to endorse or not endorse an item, meaning that person- and item-level information can be compared directly. Similarly, item response models for polytomous items yield difficulty parameters that represent the ability levels at which people are equally likely to endorse the first vs. second response category, the second vs third, and so on. Ali, Chang, and Anderson (2015) developed a method for computing a single difficulty value to characterize a polytomous item, which they refer to as a location index based on the item response function (LI_{IRF}). The LI_{IRF} yields an ability level that specifically balances the probability of being on the higher or lower end of an item's scale.

We present LI_{IRF} values in Table 4, ordered from lowest (i.e., "easiest") to highest (i.e., "hardest"). The LI_{IRF} values are arrayed along the general factor with revenge items

on the easier end (the revenge items are reverse-scored, and so reflect the disavowal of revenge toward the offender), benevolence items being slightly more difficult, and avoidance items on the more difficult end (the avoidance items are also reverse-scored, so they reflect a willingness to approach and re-establish a relationship with the offender). This array of items suggests that the general factor is indeed an attitudinal continuum that runs from hostility to friendliness.

Did Apologies Move Participants' Scores toward the Friendly End of the Continuum?

A valid measure of a latent dimension should respond to external causal forces that, according to theory and previously established results, alter people's standing on that latent dimension. Indeed, a modern theory of validity posits that causality is the most important criterion for assessing validity (Borsboom et al., 2004). One of the best-documented causes of scores on measures of forgiveness is the extent to which the transgressor apologizes for the transgression (Fehr, Gelfand, & Nag, 2010). Therefore, scores on a valid measure of forgiveness should increase when transgressors apologize (and decrease when transgressors aggravate the harm). Item response models have the desirable property of placing people's positions on the underlying trait (also known as "person abilities") and item difficulties (such as LI_{IRF} values) on the same metric. Consequently, we can directly compare person abilities and item difficulties to understand where a person resides on the hostility-friendliness continuum. If the hostility-friendliness continuum is a valid measure of the dimension in which forgiveness occurs, apologies should shift participants' ability levels toward the more difficult end of the continuum (i.e., the endorsement of items related to friendliness) and aggravating

messages should shift participants' responses toward the easier end of the continuum (e.g., the disavowal of items related to hostility).

To test this prediction, we first ensured that responses on the TRIM-NCO were invariant across experimental conditions (i.e., no transgression vs. apologetic vs. control-message vs. aggravating). To do so, we compared configural, metric, and scalar invariant models according to their fit indices (see supplemental information). We found that CFI decreased by no more than .01 after including the constraints required to assess each type of invariance (Cheung & Rensvold, 2002); therefore, we retained a scalar-invariant model and concluded that the latent variables represent the same underlying constructs across all four experimental conditions.

After confirming scalar invariance, we analyzed whether participants in the different post-transgression conditions, described in the methods section above, evinced different ability levels on the general factor. Distributions of ability levels plotted above item difficulties are displayed in Figure 2. For statistical analyses, we used the control-message condition as the reference group, against which we compared the effects of the apologetic messages, aggravating messages, and (for Study 2 only) the no-transgression condition. We report unstandardized coefficients here.

Consistent with expectations, relative to participants who were harmed but subsequently received the control message, scores on the general factor were higher for participants who did not experience a transgression, $b = .712$, $se = .184$, $p < .001$, slightly higher for participants who were harmed but subsequently received an apology, $b = .197$, $se = .088$, $p = 0.025$, and lower for participants who were harmed but subsequently received an aggravating message, $b = -.468$, $se = .087$, $p < .001$. None of

the messages influenced participants' scores on the revenge and benevolence specific factors, with one exception: Compared to harmed participants who subsequently received the control message, participants in the no-transgression condition evinced lower scores on the benevolence specific factor, $b = -.310$, $se = .099$, $p = .002$, and the revenge specific factor, $b = -0.878$, $se = .222$, $p < .001$, suggesting that they felt less benevolent and more vengeful toward their interaction partners than did participants who were harmed and then received the control message in response, conditional on their placement along the general factor. Inasmuch as we should expect a measure of the psychological dimensions in which forgiveness takes place to decrease in response to harms for which transgressors do not apologize (as was the case with the general factor), the counterintuitive results that emerged from comparing scores on the benevolence and revenge specific factors across all four experimental conditions suggest that these specific factors do not, in fact, reflect changes in constructs that could be meaningfully conceptualized as forgiveness (Borsboom et al., 2004).

STUDIES 1-3: DISCUSSION

Studies 1-3 involved nearly identical experiments with a US online sample, a US laboratory sample of university students and community-dwelling adults, and a Japanese online sample. With those data, we tested the hypothesis that forgiveness is prosocial change along an attitudinal continuum that runs from hostility to friendliness. To do so, we concentrated on a bifactor (S-1) model that specified participants' scores for the items on the TRIM-NCO as caused by one general factor (which we conjectured to be coextensive with the hypothesized hostility-friendliness continuum) and two specific factors (one for benevolence and one for revenge). To examine the predictive

validity of those three factors, we correlated participants' factor scores with their scores on four different experimental economic games that measure forgiveness-relevant social motivations (Billingsley & Losin, 2017). The general factor was significantly associated with scores on all four games, and in the directions one would expect if that general factor was indeed coextensive with a latent attitudinal continuum that runs from hostility to friendliness. The specific factors representing the revenge items and the benevolence items were each associated with scores on only one of the four games, and not to others with which they should also be related if they measure a forgiveness-relevant process. The consistent usefulness of the general factor for predicting economic game behavior suggests that it might be the factor that most reliably uncovers the behaviorally relevant motivational changes underlying forgiveness.

In further support of a unidimensional model of forgiveness, we found that nearly all diagnostic analyses of the bifactor (S-1) model indicated that the TRIM-NCO is unidimensional enough to treat it as such: The general factor explains over 70% of variance in item responses, exhibits high internal consistency, and produces a tolerable level of bias when compared to a single-factor model. We also found that this general factor can be dependably estimated simply with the mean of all 17 of the items.

To better characterize the general factor, we analyzed the item difficulties from the general factor, which showed a clear clustering of our *a priori* categorized (reverse-scored) revenge items at the "easier" end of the scale, benevolence items being somewhat more difficult, and (reverse-scored) avoidance items being the most difficult. This arrangement of item difficulties suggests that the general factor does appear to be

an attitudinal continuum that runs from hostility (i.e., a willingness to harm) to friendliness (i.e., an interest in establishing or restoring a positive relationship).

In additional support of the hypothesis that forgiveness is a process of prosocial change along a hostility-friendliness continuum, which is coextensive with the general factor recovered from a bifactor (S-1) model of the TRIM-NCO, we found that apologies, a well-established cause of forgiveness, enabled participants to endorse more difficult items than participants who received control or aggravating messages. We found furthermore that the specific factors for benevolence and revenge did not change in response to apologies as they should have if they indeed measured forgiveness: Causality is the key criterion for establishing validity (Borsboom et al, 2004), and only the general factor passes this key test that any valid measure of forgiveness should (Borsboom et al., 2004; Fehr, Gelfand, & Nag, 2010).

STUDIES 4 & 5

In Studies 1-3, we evaluated the hypothesis that forgiveness between strangers reflects prosocial change along a motivational-attitudinal dimension that runs from hostility to friendliness. However, forgiveness often occurs in pre-existing relationships, so it is important to evaluate whether a similar motivational-attitudinal dimension appears to underlie measures of forgiveness in the context of ongoing relationships. It is likewise important to establish that any hostility-friendliness continuum that appears to cause scores on one measure of forgiveness also appears to cause scores on others: Coherent theories of measurement require that empirical entities are kept conceptually distinct from the tools used to measure them (Markus & Borsboom, 2013).

To address these issues, we conducted two more studies to apply the traditional correlated factors model and the bifactor (S-1) model to the original 18-item Transgression-Related Interpersonal Motivations Inventory (TRIM-18; McCullough, Cohen, & Root, 2006), which was designed to measure forgiveness following a transgression committed by a familiar person in a real-world setting. Furthermore, we sought to generalize our findings to self-report instruments beyond the TRIM Inventory, so we also examined participants' responses on the Decisional Forgiveness and Emotional Forgiveness Scales (Hook et al., 2009; Hook et al., 2012; Worthington et al., 2007). These additional scales enabled us to determine whether the general factor underlying the TRIM-18 suffuses other forgiveness measures as well. As an external measure of the validity of the latent variables we estimated with these approaches, we correlated those latent variables with a single-item measure of forgiveness.

STUDIES 4 & 5: METHOD

Participants

Study 4. Participants were 168 undergraduate students recruited from introductory psychology classes at a Southeastern University in the United States (distinct from that of Study 2; 59.5% female; age not collected). Participants who were of East Asian nationality were excluded so as not to confound a broader cross-national project design that involved both Study 4 and Study 5. Participants completed the online in exchange for course credit.

Study 5. Participants were 158 undergraduate students recruited using the psychology participant pool at a university in Japan (51.2% female; age not collected). East Asian participants were targeted for recruitment, resulting in an ethnically

homogenous sample. Participants completed the survey in a laboratory in exchange for 700 JPY.

Procedure

Study 4. We collected data using an online Qualtrics survey. To study forgiveness in real-world transgressions, we instructed participants to “[t]hink of a time that a close other person did something to upset you, hurt you, or otherwise commit an offense that caused a rift in your relationship.” We also asked participants to describe the context and outcome of the offense. After describing the transgression, participants completed several self-report measures, including the TRIM-18, the Decisional Forgiveness Scale, the Emotional Forgiveness Scale, and the single-item measure of forgiveness. Items within each measure were presented in random order to limit carry-over effects. Participants also completed other measures beyond the scope of this paper.

Study 5. Study 5 was highly similar to Study 4. Participants completed back-translated versions of the scales in Study 4 (Ohtsubo et al., 2015). The only procedural difference from Study 4 was that participants completed the survey in the laboratory.

Measures

Transgression-Related Interpersonal Motivation Scale (Close Others)

We sought to measure forgiveness with four measures. First, we used the 18-item Transgression-Related Interpersonal Motivation Scale for close others (TRIM-18; McCullough, Root, & Cohen, 2006). Participants were instructed as follows: “For the following questions, please indicate your current thoughts and feelings about the person who hurt you; that is, we want to know how you feel about that person right now. Next to

each item, circle the number that best describes your current thoughts and feelings.” Responses ranged from 1 (“Strongly Disagree”) to 5 (“Strongly Agree”). As in Studies 1-3, negatively worded items (i.e., items indicating less forgiveness) were reverse-scored so that higher scores implied more forgiveness. For example, agreement with the items “I will make him or her pay” from the revenge scale and “I withdraw from him/her” from the avoidance subscale were recoded so that higher scores implied less forgiveness. In contrast, agreement with the item “Despite what he/she did, I want us to have a positive relationship” from the benevolence subscale implied more forgiveness.

Decisional Forgiveness

Second, we used the Decisional Forgiveness Scale (DFS; Worthington et al., 2007), which was designed to measure the degree to which the victim of a transgression deliberately works to replace negative behavior toward a transgressor with positive, prosocial behavior (Hook et al., 2009; Hook et al., 2012). Participants were instructed as follows: “Think of your current intentions toward the person who hurt you. Indicate the degree to which you agree or disagree with the following statements.” For example, participants were asked how much they agree with the statement, “I will not talk with him or her.” The DFS is an 8-item scale with response options ranging from 1 (“Strongly Disagree”) to 5 (“Strongly Agree”). The DFS consists of a 4-item prosocial intention subscale, and a 4-item inhibition of harmful intention subscale. We scored participants’ DFS responses so that higher scale scores indicated greater decisional forgiveness.

Studies 4 and 5 were planned in early 2015. Between then and now, a five-item measure of decisional forgiveness was developed to supersede the eight-item version

we used here (Davis et al., 2015). Even so, the original eight-item version continues to be widely used (Bartholomaeus & Strelan, 2016; Cavalcanti, de Holanda Coelho, Rezende, Vione, & Gouveia, 2018; Kurniati et al., 2017; Sandage et al., 2015).

Emotional Forgiveness

Third, we used the Emotional Forgiveness Scale (EFS; Worthington et al., 2007), which measures the degree to which a victim replaces negative emotions towards a transgressor (e.g., anger) with positive emotions (e.g., compassion; Hook et al., 2009). Participants were instructed as follows: “Think of your current emotions toward the person who hurt you. Indicate the degree to which you agree or disagree with the following statements.” For example, participants were asked how much they agree with the statement, “I no longer feel upset when I think of him/her.” The EFS is an 8-item scale with response options ranging from 1 (“Strongly Disagree”) to 5 (“Strongly Agree”). The EFS consists of a 4-item presence of positive emotion subscale, and a 4-item presence of negative emotion subscale. We scored the EFS so that higher scale scores indicated greater emotional forgiveness.

Single-item measure of forgiveness

Finally, we used a face-valid single-item measure, which read, “Have you forgiven the person for the offense?” This item was used as a criterion measure to assist us with identifying the extent to which participants’ scores on the latent variables underlying the TRIM-18, the Decisional Forgiveness Scale, and the Emotional Forgiveness Scale could be conceptualized as “forgiveness.” To complete this single-item measure, participants responded using a slider scale with response options ranging from 0 and 100. Higher scores indicated greater forgiveness. Single-item

measures have been regularly used to assess the validity of forgiveness scales (e.g., Boon & Sulsky, 1997; Darby & Schlenker, 1982; McCullough et al., 1997) and single-item measures in general often have reliabilities in the range of .6 to .7 (Wanous & Reichers, 1996).

Analyses

Analyses were similar to those in Studies 1-3. First, we fit the TRIM-18 data using the same two models that performed well for the TRIM-NCO in Studies 1-3 (i.e., the three-factor congeneric model and its analogous bifactor (S-1) model). Second, we evaluated the associations of the latent variables estimated in each model with participants' scores on the single-item measure of forgiveness. Third, we used several psychometric tests to evaluate whether the general factor from the TRIM-18 bifactor (S-1) model operates in a manner consistent with unidimensionality. Fourth, we sought to describe the motivational-attitudinal character of the general factor from the bifactor (S-1) model by examining the ordering of the item difficulties on the general factor. Last, we correlated the general factor and specific factors from the bifactor (S-1) model of the TRIM-18 with the single item measure of forgiveness.

We conducted a parallel set of analyses for the Decisional and Emotional Forgiveness Scales (Hook et al., 2009; Hook et al., 2012; Worthington et al., 2007), and examined the correlation of its general factor with the general factor estimated from the bifactor model of the TRIM-18. Having found a correlation of the two general factors that approached unity, we estimated a final bifactor model that incorporated items from the TRIM-18, the DFS, and the EFS, and then regressed the single-item forgiveness measure with the general factor and specific factors from that model.

STUDIES 4 & 5: RESULTS

Analyses were conducted using Mplus version 7 (Muthén & Muthén, 1998-2012). See supplemental information for data and syntax. We report standardized coefficients for all outcomes.

Factor Analysis of the TRIM-18

We modeled the TRIM-18 as we modeled the TRIM-NCO in Studies 1-3. Due to the limited sample sizes of Studies 4 & 5, we had trouble estimating configural and metric invariance with ordinal indicators because it required estimating too many threshold parameters for the sample size. Therefore, we tested invariance by treating indicators as continuous (see supplemental information). Due to the poor model fit of the initial configural model, we added correlations among indicators as suggested by Mplus's modification Indices. This enabled us to test for a reduction in model fit after adding constraints, which is displayed in Table 2. We found evidence for metric but not scalar invariance ($\Delta CFI = -.012$); however, a scalar invariant model with categorical indicators yielded adequate model-data fit, $CFI = .964$. To maintain efficiency and parallel reporting with Studies 1-3, we proceeded to combine data from Studies 4 and 5 into a single data set, but we caution readers to consult the supplemental information for their separate analyses. We first examined the predictive performance of the three-factor model (which provided the best performance of all three congeneric models in Studies 1-3) and the bifactor (S-1) model. The congeneric three-factor model fit the data reasonably well, $CFI = .962$, as did the bifactor (S-1) model, $CFI = .960$.

Which Factors from the Three-Factor Congeneric Model of the TRIM-18 Predict Scores on the Single-Item Forgiveness Measure?

We regressed the single-item measure of forgiveness on each of the factors in the three-factor (avoidance, revenge, and benevolence) congeneric model of the TRIM-18. The single-item forgiveness measure was not predicted by the avoidance factor, $b = -.062$, $se = .123$, $p = .616$, but was predicted by the benevolence factor, $b = 0.508$, $SE = 0.122$, $p < .001$, and the revenge factor, $b = 0.250$, $SE = 0.050$, $p < .001$. Given the high correlation of the avoidance and benevolence factors, $r = .905$, $p < .001$, it is unsurprising that one of them failed to predict unique variance in the single-item forgiveness measure.

Which Factors from the Bifactor (S-1) Model of the TRIM-18 Predict Scores on the Single-Item Forgiveness Measure?

Next, we regressed the single-item measure of forgiveness on the general factor and the benevolence and revenge specific factors from the bifactor (S-1) model. Scores on the single-item forgiveness measure were significantly predicted by the general factor, $b = .554$, $se = .044$, $p < .001$, but not the benevolence specific factor, $b = -.076$, $se = .057$, $p = .185$, while also being predicted by the revenge specific factor, $b = .164$, $se = .055$, $p = .003$.

Do the Properties of the TRIM-18 Bifactor (S-1) Model Support Unidimensionality?

Based on the good performance of the general factor from the bifactor (S-1) model in predicting the single-item measure of forgiveness, we examined its psychometric properties in five ways to determine whether the TRIM-18 could be functionally treated as unidimensional, using criteria outlined by Rodriguez et al. (2016). These results were very similar to the results involving the TRIM-NCO in Studies 1-3. First, we found that the general factor had high internal consistency, McDonald's ω

Hierarchical = .888, whereas the benevolence specific factor yielded unacceptable internal consistency, McDonald's ω Hierarchical Subscale = .019, and that the revenge specific factor yielded a lower, but still reasonable, internal consistency, McDonald's ω Hierarchical Subscale = .729. Second, estimates of the construct reliability for the general factor, $H = .969$, the benevolence specific factor, $H = .315$, and the revenge specific factor, $H = .868$, indicated that the general factor was well-specified, the benevolence factor was poorly specified, and the revenge factor was well-specified.

Third, to understand whether item responses were sufficiently explained by the general factor, we examined the explained common variance (ECV), which indicated that the general factor explained 73.7% of variance in item responses while 26.3% of variance was accounted for by specific factors. With PUC = 0.837 and ECV = 0.737, one could expect little bias if one were to specify a unidimensional model.

Fourth, we directly examined the bias in factor loadings that would result if researchers used a unidimensional model rather than the bifactor (S-1) model, on the assumption that the bifactor S-1 model is correctly specified and the unidimensional model is not. Average bias in the factor loadings of the unidimensional model was 21.0%, which is beyond Muthen, Kaplan, and Hollis's (1987) proposed acceptable range of 10-15%, indicating that modeling TRIM-18 responses as unidimensional may lead to a non-ignorable bias when estimating factor loadings.

Fifth, we correlated the general factor with a simple mean of all 18 items from the TRIM-18. The two measures were almost perfectly correlated, $r = .961$, $p < .001$. Unsurprisingly, this simple 18-item composite was also significantly correlated with people's responses to the single-item forgiveness measure, $r = .587$, $p < .001$. As was

the case with the TRIM-NCO in Studies 1-3, these results suggest that the general factor can be estimated with high fidelity simply by taking the mean of all 18 items.

Taken together, these analyses suggest in the main that scores on the TRIM-18 can be meaningfully (if imperfectly) conceptualized as resulting from a single latent variable, though they also point to the existence of a residual second-order factor that mostly reflects variance unique to the revenge items. The meaning and practical importance of that revenge-specific factor remains unclear, however.

Is the General Factor a Continuum from Hostility to Friendliness?

As in Studies 1-3, we examined the ordering of the items' difficulty levels on the general factor to infer the nature of the dimension that generated that array of item difficulties. To do so, we computed LI_{IRF} for each item from the general factor (Ali et al., 2015), which are presented in Table 4. Again, we found that LI_{IRF} values were sorted along the general factor with revenge items on the easier end and a mixture of avoidance and benevolence items on the more difficult end. We also found that LI_{IRF} values for each item were strongly correlated with those found using analogous items in Studies 1-3, $r = .832$, $p < .001$, and their location ranks were also correlated (though less so), $r = .513$, $p < .001$, providing further evidence for consistency in item difficulties across relationship types, as well as evidence that the general factor is indeed an attitudinal continuum that runs from hostility to friendliness.

Does a Single General Factor Pervade Other Measures of Forgiveness?

Next, we sought to determine whether the hostility-friendliness continuum recovered from participants' scores on the TRIM-18 also explains people's scores on the items of the Decisional Forgiveness Scale (DFS) and the Emotional Forgiveness

Scale (EFS; Hook et al., 2009; Hook et al., 2012; Worthington et al., 2007). To do so, we conducted analogous tests to determine how a general factor estimated from a bifactor (S-1) model of the items on the DFS and EFS corresponds to the general factor derived from the TRIM-18.

In constructing models for the DFS and EFS, we first fit a two-factor congeneric model to represent decisional and emotional forgiveness separately. This model did not fit the data well, so we correlated the residuals from some items to improve model-data fit before regressing single-item forgiveness on the two factors. The resulting two-factor model fit the data reasonably well, CFI = .952. To construct the bifactor (S-1) model for the DFS and the EFS, we scaled the general factor using the decisional forgiveness items. Again, we included some residual correlations among the decisional forgiveness items to get a model that fit reasonably well, CFI = 0.949.

Which Factors from the Two-Factor Congeneric Model and the Bifactor (S-1) Model of the Decisional and Emotional Forgiveness Scales Predict Scores on the Single-Item Forgiveness Measure?

In a regression of the single-item forgiveness measure on factors from the traditional two-factor model of the DFS and the EFS, the decisional forgiveness factor predicted scores on the single-item forgiveness scale, $b = .446$, $se = .100$, $p < .001$, as did the emotional forgiveness factor, $b = .183$, $se = .090$, $p = .041$. These results suggest that both factors contribute to predicting the single item, though decisional forgiveness appears to dominate in its explanatory ability.

We then regressed the single-item measure of forgiveness on the general factor and emotional forgiveness specific factor from the bifactor (S-1) model of the DFS and

EFS. As we found with the TRIM-18, the general factor remained a strong predictor of the single-item measure of forgiveness, $b = .625$, $se = .043$, $p < .001$. The emotional forgiveness specific factor remained predictive, though less so, $b = .141$, $se = .046$, $p = .002$. We also correlated the general factor estimated in the bifactor (S-1) model of the DFS and the EFS with the general factor estimated in the bifactor (S-1) model of the TRIM-18. The two estimates of the general factor were nearly identical, $r = .927$, $p < .001$.

Do the Properties of the DFS/EFS Bifactor (S-1) Model Support Unidimensionality?

First, we found that the general factor had high internal consistency, McDonald's ω Hierarchical = .923. In contrast, the emotion specific factor yielded near-zero reliability, McDonald's ω Hierarchical Subscale $< .01$, which is highly surprising in light of the fact that this factor predicted significant variance in the single-item measure of forgiveness. Second, we examined construct reliability for the general factor, $H = .940$, and the emotion specific factor, $H = .628$, indicating that our general factor is near-perfectly specified and the emotion factor is poorly specified.

Third, to understand how well the general factor explained item responses, we examined the explained common variance (ECV), which indicated that the general factor explained 82.9% of variance in item responses while 17.1% of variance was accounted for by the emotion specific factor. In this case, with $PUC = 0.767$ and $ECV = 0.829$, we can expect very little bias if we were to specify a unidimensional model.

Fourth, we directly examined the bias between the factor loadings of the unidimensional model (misspecified) and the bifactor (S-1) model ("correctly" specified).

We observed an average bias of 1.02%, indicating that a unidimensional model of the DFS and the EFS would lead to very little bias in estimating factor loadings.

Which Factors from the Bifactor (S-1) Model of the TRIM-18, the DFS, and the EFS Predict Scores on the Single-Item Forgiveness Measure?

After we established the near-equivalence of the general factor derived from the bifactor (S-1) model of the TRIM-18 and the general factor derived from the bifactor (S-1) model of the DFS and EFS (the factor-factor correlation was $r = .927$, $p < .001$), we examined a bifactor model (S-1) that included the items from all three scales (the TRIM-18, the DFS, and the EFS). We then examined which of the modeled factors predicted scores on the single-item forgiveness measure. To fit this model, we used the avoidance factor from the TRIM-18 as the scaling factor and modeled specific factors for benevolence, revenge, decisional, and emotional forgiveness. Unsurprisingly, we found that the general factor retained its superior ability to predict the single-item forgiveness measure, $b = .580$, $se = .043$, $p < .001$. Interestingly, the revenge specific factor also retained some unique ability to predict single-item forgiveness, $b = .367$, $se = .170$, $p = .031$. None of the other specific factors were uniquely associated with scores on the single-item forgiveness measure (see supplemental information).

STUDIES 4 & 5 DISCUSSION

In Studies 4 and 5, we used samples of non-East Asian U.S. and Japanese undergraduates to determine if our findings based on the TRIM-NCO in Studies 1-3 extended to relationships involving close others and to measures beyond variants of the TRIM. We largely replicated the results of Studies 1-3, which showed that the general factor from a bifactor (S-1) model of TRIM-NCO provided excellent estimation of

people's responses to single-item self-reported forgiveness. Item difficulties of the items on the TRIM-18 were substantially correlated with the item difficulties of the analogous items on the TRIM-NCO from Studies 1-3. To better characterize the general factor, we analyzed the item difficulties from the general factor, which showed a clear clustering of (reverse-scored) revenge items at the easier end of the continuum, and avoidance and benevolence items at the more difficult end of the continuum. This arrangement of item difficulties suggests that the general factor is coextensive with a motivational-attitudinal continuum that runs from hostility (i.e., a willingness to harm) to friendliness (i.e., an interest in establishing or restoring a positive relationship).

We also used data from the Decisional Forgiveness Scale and Emotional Forgiveness Scales (Hook et al., 2009; Hook et al., 2012; Worthington et al., 2007) to further evaluate the hypothesis that forgiveness is change along hostility-friendliness continuum. We found that the general factor from the bifactor (S-1) model of the DFS and EFS exhibited desirable psychometric properties, predicted the single-item measure of forgiveness well, and was nearly identical (as evinced by the very high correlation) to the general factor estimated from the TRIM-18. Finally, we found that combining multiple forgiveness scales into a single bifactor (S-1) model did not substantively change our interpretation of the general factor, which further supports the hypothesis that forgiveness reflects change along a hostility-friendliness continuum that exists independently of the psychometric instrument used to measure it.

GENERAL DISCUSSION

Forgiveness has long been conceptualized as a process of psychological change with respect to a harmdoer, but change in what? Through the years, scholars have

proposed various models of the psychological changes that constitute forgiveness (e.g., McCullough et al., 2003; Subkoviak et al., 1995), but the tools used to measure forgiveness do not always map well onto corresponding theory. Often, the forgiveness constructs defined by theory appear to be more complex than the underlying structure of the psychometric instruments designed to capture those theoretical constructs. Here, with the goal of obtaining a better theoretical understanding of the underlying structure of the psychological phenomena that change when people forgive, we tested a variety of modeling approaches for a commonly used measure of forgiveness—the Transgression-Related Interpersonal Motivations (TRIM) Inventory (McCullough et al., 2006)—with separate variants of the scale for close and non-close relationships. In doing so, we specifically sought to determine whether a bifactor modeling approach, which specifies forgiveness as a single underlying continuum that ranges from hostility to friendliness, along with other potentially substantive item-specific factors, would provide additional clarity about the psychological dimensions that underlie forgiveness.

In three experiments involving staged transgressions between strangers, we found that the general factor from a bifactor (S-1) model yielded a measure of forgiveness with several desirable properties: First, it predicted every economic game outcome in theory consistent ways (defections in an iterated prisoner's dilemma game, greater transfers in a trust game and dictator game, and lower punishment in a pay-to-punish game), whereas no single factor in a three-factor congeneric model reliably predicted all outcomes. Second, our examination of the general factor's properties revealed that it could be considered unidimensional (that is, could be specified as a single factor model) without losing much fidelity in the construct. Third, the general

factor responded to apologetic and aggravating messages in the predicted directions; the benevolence and revenge-specific factors did not.

In two other studies involving recalled transgressions, the general factor from the bifactor (S-1) model exhibited similarly desirable properties: First, the general factor exhibited superior prediction of a single-item forgiveness measure compared to any of the congeneric factors in a three-factor model. Second, the general factor exhibited several properties supporting unidimensionality, though unlike the TRIM-NCO Inventory from the aforementioned experimental investigations, the TRIM-18 appeared to retain a reasonable degree of multidimensionality, particularly with respect to the residual variance associated with revenge items. And third, the properties of the general factor were nearly identical when applied to the Decisional and Emotional Forgiveness Scales, which suggests that the underlying forgiveness construct can likely be recovered regardless of which scale is used.

Our hypothesis that the trait underlying the measures of forgiveness we examined here reflects an attitudinal continuum running from hostility to friendliness is reinforced by the fact that the item difficulties of the items on both versions of the TRIM inventory aligned along a continuum that ranges from overcoming vengeance on the “easier” end to restoring friendly relations on the “difficult” end. Because a hostility-friendliness dimension appears to suffuse interpersonal behavior in general (as exemplified in the interpersonal circumplex model of interpersonal behavior; Gurtman, 2009), it is to some extent unsurprising to discover that a similar continuum underlies forgiveness, though it has the potential to be critically important for future theory and research on forgiveness. Our conclusion that forgiveness is unidimensional is

strengthened considerably by the correlations of the general factor recovered here with participants' scores on four different laboratory experimental economic games, including games that reflect both punitiveness and cooperativeness. Other work has shown that the variance shared among people's scores in cooperative games appears to be caused by a common tendency to cooperate that manifests itself both in the lab and in real-life social interactions (McAuliffe et al., 2018; Peysakhovich et al., 2014; Wilhelm, Kaltwasser, & Hildebrandt, 2018), so we are inclined to conclude that the general factor we found here reflects variation in a single broad motivational or attitudinal construct that, on the positive end of the continuum, manifests itself through cooperative behavior toward one's transgressor in daily life.

Measuring Forgiveness in Close vs. Non-Close Relationships

Previous research involving measures of transgression-related interpersonal motivations has used the TRIM-18 (McCullough et al., 2006) or its earlier 12-item variant (McCullough et al., 1998), which were designed to measure forgiveness in close relationships (e.g., friendships, family relationships, and romantic partnerships). In our first three experiments, we analyzed a new variant of the measure, the TRIM-NCO, which involved modifying the TRIM-18 to make it applicable to non-close relationships of the sort that researchers frequently examine in experiments. The novelty of the TRIM-NCO raises the concern that the conclusions derived from its use might not generalize across relationship types. We addressed this concern by reporting the results of two correlational studies that used the standard TRIM-18 to assess transgression-related motivations in the context of close relationships. For both close

and non-close relationships, we found that the bifactor model showed excellent fit and that its general factor reliably exhibited predictive utility.

In favor of the generalizability of our forgiveness model, we point to the fact that the properties of the general and specific factors yielded parallel conclusions for the TRIM-NCO and the TRIM-18: The general factor is a highly reliable and well-specified construct, the benevolence specific factor is poorly specified, and the revenge specific factor is well-specified and contributes to a reasonable degree of multidimensionality. These observations are consistent with prior work suggesting that the avoidance and benevolence subscales can be accurately modeled as resulting from a single underlying construct (McCullough et al., 2007; McCullough et al., 2006). To the extent that our results differed between close and non-close relationships, such differences might reflect differences in experimental methods: We relied upon recalled transgressions to investigate close relationships, but used experimentally manufactured transgressions in real time to examine non-close relationships. Although differences in outcomes for non-close vs. close relationships were minor, researchers could investigate these differences in the future by employing highly parallel methods that use both recalled and real-time transgressions involving both close and non-close others.

Do Specific Factors Reflect Method or Motive?

We argued from the results of the bifactor (S-1) model of the TRIM Inventory (and in Studies 4 and 5, the Decisional and Emotional Forgiveness Scales) that the general factor reflects an attitudinal continuum that ranges from hostility to friendliness, with a less prominent role for specific factors reflecting other psychological variables. Although we found some modest correlations between the specific factors and our

outcomes, they were not wholly consistent across outcomes, possibly undermining their utility beyond improving model-data fit. They also failed to respond to manipulations of apologies, which seriously calls into question their validity as measures of the psychological dimensions in which forgiveness takes place. It is therefore plausible that the specific factors reflect systematic responses to particular methods (such as positive vs. negative wording) that distinguish items pertaining to revenge and benevolence, rather than substantive variance that a theory of forgiveness should explain. In fact, some treatments of a bifactor model are designed to account for differences in wording (e.g., reverse-scored items) due to inherent differences in how people respond to items that are worded to be the inverse of their construct. Scholars have even noted that these models may do most of their work by accounting for implausible response patterns (Reise, Kim, Mansolf, & Widaman, 2016). Therefore, important questions remain about the *predictive* utility of modeling specific factors. In any case, the importance of the specific factors seems to us overshadowed by the prominence of the general factor and its broad conceptual and empirical utility.

Does a Unidimensional Model Oversimplify Forgiveness?

Our emphasis on the effective unidimensionality of forgiveness may prompt concerns that such an approach will obscure nuance and complexity, hindering research progress. We take a rather different view of the matter. By clarifying the (possibly) unidimensional nature of forgiveness, and by helping unify forgiveness theory and measurement more generally, our work should actually help researchers uncover nuance and explain complexity. It will do so because the loci of nuance and complexity may not be in a measure of forgiveness itself but rather in the multifaceted properties of

the situation under which transgression and reconciliation take place, in the manifold characteristics of both victim and transgressor, and in the dense web of interactions between person and situation. State forgiveness, we argue here, occurs along a singular dimension that ranges from hostility to friendliness, but it is a psychological output whose causes and consequences remain as complexly determined as ever. The measurement model and practices we put forward here will assist researchers in their continued illumination of those determinants—whether they be transgression severity, interaction history, apology sincerity, perceptions of transgressor relationship value and exploitation risk, cues to genetic relatedness, or other factors not yet proposed.

Additionally, we hasten to point out that future psychometric work on other measures of forgiveness (e.g., Recoder et al., 2019; Rye et al., 2001; Subkoviak et al., 1995) may reveal substantive dimensions of forgiveness beyond the general factor that should also be (or remain) integrated into theorizing going forward.

Conclusions

Although researchers have been studying forgiveness for more than 25 years, the rich and sometimes multifaceted conceptualizations of forgiveness that have guided this work have not been tightly moored to the psychometric realities of the tools used to measure them. The studies presented here strongly support the hypothesis that forgiveness is a process of attitudinal change, incorporating thoughts, feelings, and behavioral tendencies, along a dimension that ranges from hostility to friendliness. We recovered evidence for this underlying continuum from studies conducted in the laboratory as well as online, in the United States as well as in Japan, with transgressors who are strangers as well as with transgressors who are existing relationship partners,

and with the TRIM Inventory (McCullough et al., 2006) as well as with the Emotional and Decisional Forgiveness Scales (Hook et al., 2009; Hook et al., 2012; Worthington et al., 2007). Perhaps most notably, the underlying hostility-friendliness dimension we identified here is behaviorally relevant inasmuch as it is consistently and positively related to laboratory behaviors that reflect the propensity to cooperate in daily life (McAuliffe et al., 2018; Peysakovich, Nowak, & Rand, 2014).

Although the bifactor model recovered factors other than the general factor, their heuristic value going forward remains unclear. They did not succeed in identifying any correlates of forgiveness that the general factor failed to identify, their correlations with the experimental economic games seemed arbitrary, they manifested themselves slightly differently in studies of laboratory transgressions than in studies of real-life transgressions, and they responded nonsensically to apology manipulations. In contrast, the general factor explains the huge preponderance of the variance in the individual questionnaire items, as well as in an external single-item measure of forgiveness. It also reliably predicts participants' cooperative behavior, it never yields nonsensical correlations with external validation criteria, and it responds as predicted to apologies and other post-transgression communications. In other words, the general factor behaves in every way like a measure of forgiveness should.

Going forward, we believe substantial insights might be gained by viewing forgiveness as prosocial change along a hostility-friendliness attitudinal continuum. In particular, the proposition that forgiveness reflects attitude change implies that much could be learned about forgiveness by applying the basic principles of attitude change. For instance, an attitudinal conception of forgiveness suggests that forgiveness might

1223 be increased by producing imagery of pleasant interaction with the transgressor,
1224 generating reasons why forgiveness would be a good idea, pairing stimuli related to the
1225 transgressor with pleasant stimuli, enacting behaviors that are incompatible with holding
1226 a negative attitude toward the transgressor, or inducing cognitive dissonance
1227 (Albarracin & Shavitt, 2018; Bohner & Dickel, 2011; Dalege et al., 2016). More
1228 generally, we believe these results demonstrate the promise of seeking a closer union
1229 between our theories of forgiveness and the empirical realities of the measures with
1230 which we seek to assess the constructs those theories invoke.
1231

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Table 1. Order of events for Studies 1, 2, and 3, including the partner's preprogrammed behavior, the timing of assessments for relationship value and exploitation risk, and the confederate's messages to participants.

Experiment Stage	Description	
	Round	Event
Prisoner's Dilemma Game	1	Confederate Cooperates
	2-12	Confederate plays generous tit-for-tat <i>Message encouraging continued cooperation</i>
	13-19	Confederate defects (generous tit-for-tat in Study 2 no transgression condition) <i>Message: Apology Manipulation</i>
	20-21	Confederate Cooperates
	22-29	Confederate plays generous tit-for-tat
Second Economic Game	Trust Game (Studies 1, 2, and 3) or Dictator Game (Study 1) or Pay-to-Punish Game (Study 1)	
Forgiveness	Transgression-Related Interpersonal Motivations	

Note. This table of the experimental protocols includes only the events that pertain to this manuscript. Other measures were taken during the PDG but are not reported here because they are beyond the scope of this manuscript; results using these measures are available in the manuscript written to be a complement to this (Billingsley et al., in prep).

Table 2: Invariance Across Laboratories (Studies 1-3)

Model	χ^2 (df), p	$\Delta\chi^2$	CFI	Δ CFI	TLI	RMSEA [90% CI]	SRMR
Studies 1-3							
Configural	1899.464 (348), < .001	NA	0.955	NA	0.947	0.072 [0.069, 0.075]	0.045
Metric	2182.72 (382), < .001	283.256 (34), < .001	0.948	0.007	0.944	0.074 [0.071, 0.077]	0.211
Scalar	2563.239 (410), < .001	380.519 (28), < .001	0.938	0.010	0.938	0.078 [0.075, 0.081]	0.212
Studies 4 & 5							
Configural	475.745 (242), < .001	NA	0.95	NA	0.93	0.077 [0.067, 0.087]	0.06
Metric	529.875 (260), < .001	54.13 (18), < .001	0.94	0.008	0.93	0.08 [0.07, 0.09]	0.19
Scalar	596.288 (272), < .001	66.413 (12), < .001	0.93	0.012	0.92	0.086 [0.076, 0.095]	0.09
Scalar (ordinal)	766.602 (323), < .001	170.314 (51), < .001	0.96	NA	0.97	0.092 [0.083, 0.1]	NA

Note: For studies 4 & 5, we did not specify ordinal indicators when testing for invariance due to sample size limitations.

However, scalar invariance was estimable with ordinal indicators, so it is also included for comparison. Invariance was tested based on Δ CFI $\leq$.10 (Cheung & Rensvold, 2002).

Table 3. Standardized regression coefficients and standard errors from congeneric three-factor and bifactor (s-1) models predicting forgiveness-relevant outcomes.

Outcome	Three-Factor Model			Bifactor (S-1) Model		
	Avoid	Revenge	Benevolence	General Factor	Revenge-Specific	Benevolence-Specific
Studies 1-3						
PDG	-.321 (.051)***	-.006 (.039)	-.146 (.064)*	-.415 (.047)***	-.016 (.020)	-.047 (.033)
TG	.163 (.056)**	-.079 (.043)	.156 (.066)*	.250 (.027)***	-.110 (.083)	.080 (.039)*
DG	.302 (.132)*	.031 (.078)	.063 (.166)	.380 (.034)***	.030 (.061)	.021 (.056)
PTPG	-.041 (.137)	-.274 (.077)***	-.074 (.174)	-.262 (.052)***	-.216 (.053)***	-.052 (.055)
Studies 4 & 5						
Single-Item Forgiveness	-.062 (.123)	.250 (.050)***	.508 (.122)***	.554 (.044)***	.164 (.055)**	-.076 (.057)

Note: All items were scored so greater values indicate more forgiveness. * $p < .05$, ** $p < .01$, *** $p < .001$

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Table 4. Raw means for item responses and item difficulties based on the Location Index from the Item Response Function for both sets of studies, sorted by item difficulty.

Studies 1-3				Studies 4 & 5			
<i>Item</i>	Difficulty	Mean	Scale	<i>Item</i>	Difficulty	Mean	Scale
4	-1.307	4.43	REV	1	-2.740	4.67	REV
17	-1.157	4.29	REV	17	-2.249	4.55	REV
1	-1.022	4.17	REV	13	-2.088	4.56	REV
13	-0.960	4.09	REV	4	-2.024	4.40	REV
16	-0.672	3.78	BEN	9	-1.871	4.19	REV
14	-0.557	3.63	BEN	3	-1.472	3.61	BEN
8	-0.493	3.56	BEN	10	-1.449	3.55	BEN
3	-0.475	3.53	BEN	15	-1.386	3.95	AVO
10	-0.389	3.44	BEN	18	-1.386	3.69	AVO
6	-0.344	3.39	BEN	14	-1.386	3.33	BEN
2	-0.333	3.40	AVO	11	-1.367	3.64	AVO
5	-0.325	3.39	AVO	5	-1.292	3.66	AVO
18	-0.312	3.38	AVO	2	-1.257	3.50	AVO
11	-0.299	3.37	AVO	8	-1.208	3.59	BEN
15	-0.164	3.21	AVO	6	-1.177	3.37	BEN
12	-0.056	3.07	AVO	12	-1.147	3.35	BEN
7	0.111	2.87	AVO	16	-1.103	3.19	BEN
9	-	-	-	7	-1.009	3.11	AVO

Note: Items were scored so that higher values indicated greater forgiveness. Item 9 was dropped from Studies 1-3 due to its especially poor performance as an indicator.

Figure 1. A bifactor (S-1) model applied to the TRIM-18. Specific domains are modeled separately from the general factor, with the exception of a reference domain, which is used to define the scale of the general factor.

Figure 2. Histograms of factor scores ('Forgiveness Ability') from the general factor fit across all three experiments and separated by experimental condition. Item difficulties calculated using L_{IRF} are plotted along the same axis as factor scores for comparison. Item content for each corresponding item number is available in Appendix A; items from the Revenge subscale are in red, items from the Benevolence subscale are in green, and items from the Avoidance subscale are in yellow. Separate figures for each experiment are displayed individually in the supplemental information.

Appendix A. Items from the Transgression Related Interpersonal Motivations
questionnaire for Non-Close Others.

For the following questions, please indicate your current thoughts and feelings about [Target] using the scale below. Even though you will never encounter [Target] again, we are interested in how you think you would respond if you were to encounter [Target] in your daily life.

- 1 = strongly disagree
- 2 = mildly disagree
- 3 = agree and disagree equally
- 4 = mildly agree
- 5 = strongly agree
- 6 = I prefer not to answer

1. I would want to make him/her pay for treating me badly today.
2. I would try to keep as much distance between the two of us as possible.
3. I would have good will for him/her.
4. I would hope for something bad to happen to him/her.
5. I would have nothing to do with him/her.
6. I would try to put aside any reservations I had in order to develop a good relationship with him/her.
7. I would not trust him/her.
8. I would be willing to work toward a positive relationship with him/her.
9. I would want to see him/her get what he/she deserves.
10. I would act warmly towards him/her.
11. I would avoid contact with him/her.
12. I would be very happy to interact with him/her.
13. I would want to get even with him/her.
14. I would try to give up negative feelings toward him/her.
15. I would avoid working with him/her.
16. I would be willing to let go of my anger towards him/her.
17. I would want to seek revenge.
18. I would try to avoid him/her.

Note: The 9th item exhibited low factor loadings across all modeling techniques and experiments; therefore, we suggest that future research omit this item to create a scale of 17 items.