© Kamla-Raj 2019
PRINT: ISSN 0975-1122 ONLINE: ISSN 2456-6322
Int J Edu Sci, 26(1-3): 14-20 (2019)
DOI: 10.31901/24566322.2019/26.1-3.1084

The Brain Mechanisms for Processing Information Regarding Empathic and Forgivability: A Systematic Review

Anh-Chuong Huynh-Lam[1] and Vinh-Long Tran-Chi[2,3*]

[1]Faculty of Science Education, Ho Chi Minh City University of Education, Ho Chi Minh City, Vietnam
[2]Faculty of Psychology, Ho Chi Minh City University of Education, Ho Chi Minh City, Vietnam
[3]Educational Psychology Research Group, Ho Chi Minh City University of Education, Ho Chi Minh City, Vietnam

KEYWORDS Empathy. Empathic and Forgivability Judgements. Forgiveness

ABSTRACT The aim of this systematic review was to investigate the brain mechanisms in processing information regarding empathic and forgivability. The researchers reviewed the literature in PubMed-MEDLINE with the following keywords: "empathy" or "empathic", "forgiveness" or "forgivability", "empathy and forgiveness", and "empathic and forgivability". The researchers collected and analyzed all relevant studies to answer this question and found three studies. The empathy and forgivability judgment paradigms both activated brain areas in healthy subjects and in patients with schizophrenia. However, there was no such activation in Post-Traumatic Stress Disorder (PTSD) patients. With 37 participants, the researchers discovered three studies. They found in one research that empathic and forgivability judgments in healthy subjects were correlated with significant activations of left superior frontal, orbitofrontal gyri, and precuneus. The study evaluated with schizophrenia patients activated left medial prefrontal cortex. In another study, in the PTSD no brain activity was detected.

INTRODUCTION

The scientists researched forgiveness as a variable based on trait/disposition or state/situation (Berry et al. 2005; Toussaint et al. 2015). From the dispositional or trait perspective, forgiveness refers to a disposition across time and situations where forgiving is an extension of a person's personality. Conversely, from a state or situational approach, forgiveness refers to a specific response to an interpersonal transgression, transgressor, or situation (Toussaint et al. 2015).

Empathy, defined as "the ability to understand and share in another's emotional state or context" (Cohen and Strayer 1996: 988) involves cognitive and affective components. According to most models empathy consists of at least three core components: (1) The ability to recognize emotions in oneself and others via different communicative cues such as facial expressions, speech, or behavior; (2) a cognitive component (that is, the ability to understand another's emotional state, sometimes called moral emotions), also referred to as perspective taking or theory of mind, describing the competency to take over the perspective of another person, though maintaining the essential distinction between self and other; and (3) an affective component (that is, the sharing of the emotional state of another), that is, sharing of emotional states with others or the ability to experience similar emotions as others.

A connection has already been reported between empathy and forgiveness (McCullough et al. 1997; Worthington 1998b; Zechmeister and Romero 2002). McCullough et al. (1997) conducted a sectional questionnaire and a field-controlled experiment and studied the causal role empathy plays in encouraging forgiveness. Researchers have discovered that forgiveness is a motivational behavior that avoids damaging interactions between individuals and guarantees that they are constructive rather than harmful towards someone and that empathy favorably mediates apologizing and forgiving behaviors using the model of structural equalization. It is likely that an ability to deniable a person to for-

*Address for correspondence:
Vinh-Long Tran-Chi
Faculty of Psychology,
Ho Chi Minh City University of Education,
Ho Chi Minh City, Vietnam
Telephone: +84935176278
E-mail: longtcv@hcmue.edu.vn

give others. A model of forgiveness is described in the same research, based on the thesis that only if they empathize can others be forgiven. For forgiveness, a model of empathy is researched. Authors discovered an outcome consistent with the following hypotheses: (a) the connection between forgiving one's crime and apologizing is a function of enhancing the offender's empathy and (b) forgiveness is uniquely linked to soothing behaviour. Results generally favor the link between behavior and empathy-forgiveness and have shown that empathy plays a significant part in the process of forgiveness. Worthington (1998b) researched an empathy-modesty-commitment model of forgiveness that was applied to couples in a family. The research carried out in the individual therapy and psycho-educational organizations promotes this model in which the forgiver does not face the offender. In the conclusions, the researcher stated that family therapy in which spouses, parent-child couples' or siblings must admit forgiveness and forgiving needs vis-à-vis requires a unique process that also includes empathy. In addition, the connection between forgiving procedures and compassion, modesty and engagement is also discussed in this research. Empathy as a factor in the work phase of the process of forgiveness (Enright et al. 1998) and was discovered that forgiveness has a positive impact, with greater concentrations leading to greater forgiveness (Hodgson and Wertheim 2007; Konstam et al. 2001; McCullough 2000; Worthington 1998a, 1998b). Forgiveness has been linked to both dispositional and situational empathy (Zechmeister and Romero 2002). Neuroscientific approaches can help us better understand mechanisms related to empathy and forgiveness. Over the last decades, an increasing number of studies report a close relationship between empathy and forgiveness, but few studies have used neuroscientific measures (Egleston et al. 2004; Farrow et al. 2002; Farrow et al. 2005; Farrow et al. 2001; Green et al. 2003; Lee et al. 2006; Witvliet et al. 2015).

Aim and Objective

The researchers' aim was to systematically review neuro-scientific approaches studies in the relationship between empathy and forgiveness. The primary objective is to provide accessible research with a contemporary overview. Analysis of neuro-imaging in the human will provide additional important insights into the relationship between empathy and forgiveness. To achieve this, electronic searches of database was carried out in May 2019.

METHODOLOGY

Protocol

This systematic literature review followed the PRISMA guidelines (Liberati et al. 2009) and included any study that used neuroimaging to investigate the functional anatomy of empathy and forgiveness, reported more than one participant, and was published in peer-reviewed journals and indexed in PubMed before 31 May 2019. Including all research over the previous several decades was the rationale for using this time range.

Information Sources

Identified articles using the PubMed database in the url below: http://www.ncbi.nlm. nih. gov/PubMed. The last search took place on 30 May 2019.

Search Parameters

In the PubMed database, we recognized appropriate research by looking for any items containing the phrases "empath*" OR "forgiv*" AND "empath* and forgiv*", in the title or the main body of the article AND terms referring to neuroimaging methodologies. These neuroimaging methodologies were "magnetic resonance imaging" OR "MRI" and "electroencephalography" OR "EEG" in any part of the article. The researchers also included the more general search term "brain" in an effort to pick up papers that did not use these methodologies. Studies were included in the review if (1) the research performed in humans and (2) articles written in English. Exclusion criteria included animal reports and previous review articles.

The use of the search terms generated 1366 possible papers in this systematic process with "full-text articles" (that is, excluding abstracts or conference proceedings) additional filter. To

de-duplicate documents, all recognized research must be imported into EndNote 7.4 software. Thus, the method of document monitoring was carried out blindly by the two authors of this research after the exclusion of 517 duplicate papers. Of these 849 full-text papers, 435 were excluded after filtering out reviews or meta-analysis (n = 18) and non-human or non-patient (n = 417) research. Then, according to the criteria in 2.4, the remaining 414 items were evaluated for eligibility for inclusion in the systematic literature review. Please note that no reviews or meta-analysis reported in the search using a systematic search technique as suggested in the PRISMA declaration after further inspection.

Study Selection

The complete texts of the 414 articles were examined and excluded if (1) neuroimaging information were not collected (157 papers), (2) were review papers (20 paper), (3) items not containing "empathy and forgiveness" or "empathic and forgivability" in either the title or the abstract (234 papers). Based on these criteria, another 411 papers were excluded leaving a total of 3 papers. All 3 articles (Farrow et al. 2005; Farrow et al. 2001; Lee et al. 2006) met the eligibility criteria and were included in the full review; all in English articles and full-text of these records were available. No unpublished relevant records were obtained. For more information on how documents were chosen for this evaluation, please refer to the PRISMA diagram (Fig. 1). Studies excluded from this systematic assessment.

RESULTS

Basic characteristics of *the studies included in the review.* They are divided into subsections

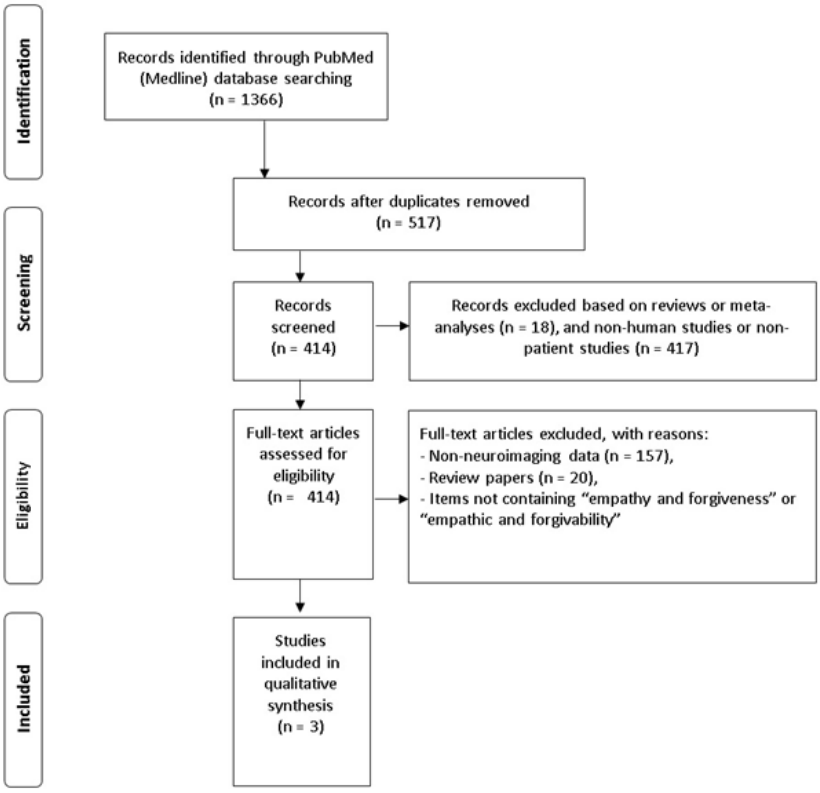

Fig. 1. PRISMA flow chart of research examining brain processes related to forgiveness and empathic data in processing environments

of healthy subjects and mental patients, being the two main reported on participant research findings. Table 1 Summarize the studies examining the brain mechanisms in processing contexts regarding forgiveness and empathic information.

Farrow et al. (2001) used fMRI to evaluate which brain structures were active in judging what one might forgive (or not forgive), empathize with, and create decisions in social circumstances. All research participants started by reading a brief scenario before making five serial choices based on two possible responses (see Table 2). Three scenarios were submitted to them, which they closely read and then imagined for 16 seconds. They then discriminated against each scenario for five (7 seconds each). Scenarios needed fundamental social reasoning decisions (condition of control), empathic judgments (that is, can you be empathic toward the offending party), and forgivability judgments (that is, is the offense forgivable). In reaction to the judgment-making process, data analysis and outcomes were limited to brain activations as scenario-reading activations were excluded. It was hypothesized that fronto-temporal brain regions would be differentially activated by empathic and forgivability judgment tasks. Activation areas are recorded using two methods — neuroanatomic name (that is, region of the brain) and area of Brodmann (BA; a functional and cytoarchitectonic parcellation of brain grey matter, similar but not identical to the brain's gyral folds). Significant activations of left superior frontal, orbitofrontal gyri and precuneus were connected with empathic and forgivability judgments. The regions of activation prevalent to empathic and forgivability judgments are separate from the separately viewed activations for each paradigm of judgment.

The study is the first to examine the relationship between empathy and forgiveness using fMRI. As such, it raises interesting questions regarding the relationship between empathy and forgiveness. However, it is given the small sample size. Analysis by Desmond and Glover (2002) proposed that for a liberal threshold of 0.05, for typical activations, approximately 12 subjects were needed to attain 80 percent power at the single voxel level. They did not discern between forgiving and not forgiving solely. The study also did not assess mental patients, such as post-traumatic stress disorder, schizophrenia, which could have changed the outcome.

Farrow et al. (2005) revealed results from a research of 13 PTSD patients (after an accident or attack on road traffic). They wished to exam-

Table 1: Studies examining the brain mechanisms in processing contexts regarding forgiveness and empathic information

Studies	*Number of subjects*	*Methods*	*Region*	*BA*	*MNI coordinates*			*Cluster size (voxels)*
					x	*y*	*z*	
Farrow et al. 2001	10 healthy subjects (7 men, 3 women, right-handed 21-51 y/o)	fMRI 1.5T Task: Social judging compared to baseline	Left superior frontal gyrus	9/10	-14	59	31	69
			Precuneus	7	-4	-64	32	18
			Orbitofrontal gyrus	11	4	50	-19	
Farrow et al. 2005	13 patients with PTSD (9 men, 4 women; right-handed; 23-56 y/o)	fMRI 1.5T Task: Social judging compared to baseline	No activation in the patients during task					
Lee et al. 2006	14 patients with schizophrenia (13 men, 1 women; right-handed;	fMRI 1.5T Task: Social judging compared to baseline	Left medial prefrontal cortex	10/9	-6	51	16	32

Abbreviations: BA, Brodmann are; MNI, Montreal Neurological Institute; PTSD, Post-traumatic stress disorder; y/o, Years old.

Table 2: Examples of the three experimental conditions used in the fMRI scanning sessions: Social reasoning, empathic judgements and forgivability judgements

Social reasoning judgements (baseline)		
Scenario: Approaching a large traffic jam on the motorway		
Details: It is not rush-hour. There have been no road-work signs		
Decision: More likely explanation for the delay		
A car crashed ahead	OR	A lorry crashed ahead
A local football match	OR	A local hockey match
A car burst into flames	OR	A car run out of petrol
A slow lorry ahead	OR	A slow tractor ahead
Flooding on the road	OR	An oil spill on the road
Empathic Judgements		
Scenario: Your boss is not themselves		
Details: They seem unusually quiet and withdrawn. You sense that something is wrong		
Decision: More likely explanation for your boss's state of mind		
Lost their house keys	OR	Lost the work safe keys
Forgot their spouse's birthday	OR	Forgot one of their parent's birthdays
Discovered mice in their house	OR	Discovered woodworm in their house
Their child was expelled from school	OR	Their child was caught shoplifting
Working excessively long hours	OR	Working under excessive pressure
Forgivability Judgements		
Scenario: A young man being visited by the police		
Details: The young man lives in your street, has recently lost his job, and told you he couldn't afford to pay his rent		
Decision: Which of the following crimes you would see as more forgivable		
Shoplifting from a supermarket	OR	Shoplifting from a newsagents
Stealing milk from a doorstep	OR	Stealing milk from a corner shop
Pickpocketing on an underground train	OR	Pickpocketing at a football match
Assaulting his girlfriend	OR	Assaulting his landlord
Driving without insurance	OR	Driving without road tax

Farrow et al. (2005) revealed results from a research

ine the way in which PTSD symptoms would impact on emotional and social cognition processing. Participants underwent fMRI with the assessment paradigm for social cognition of empathy and forgiveness before and after treatment (Farrow et al. 2001). In their research, the Cognitive Behavioral Therapy (CBT) included a part of forgiveness, resulting in brain activation "normalization" on activities that test empathy and forgivability. The empathy and forgivability judgment paradigms both activated of left superior frontal, orbitofrontal gyri, and precuneus in their previous study of healthy participants (Farrow et al. 2001), but such activation did not occur in pre- or post-therapy patients with PTSD (even at a less conservative threshold of $p<0.001$ uncorrected for multiple comparisons).

This research used a fMRI method that measured empathy and forgiveness to examine respondents diagnosed with PTSD before and after CBT. However, it was uncertain to what extent these modifications could be attributed to forgiveness that no control group was used in this research. This study concluded that CBT can promote changes in the brain area. This study, however, have not found the brain mechanisms in processing contexts regarding forgiveness and empathic information.

Lee et al. (2006) examined neural activity in patients with schizophrenia and healthy controls during forgiveness and empathic judgments. Using the same methodology as in the previous studies (Farrow et al. 2005; Farrow et al. 2001), they aimed to study the relationship between empathy and forgiveness *in patients with schizophrenia*. Two times, once during an acute episode and once after recovery, patients were scanned. They discovered that patients with acute episodes in the left medial prefrontal cortex activated regions of empathy and forgiveness scenarios to a lower degree compared to healthy control subjects. However, activation increased in the patient group upon clinical improvement. The research also discovered that

in the first scan, schizophrenia patients did not uniformly activate the right posterior fusiform gyrus for both empathic and forgivability judgments. These findings indicate that restored left-medial prefrontal cortex activation inpatients with schizophrenia may mediate improved understanding and social functioning. This brain area has been implicated in self-referential and social judgments in a large number of studies.

This research extended further on the research conducted by Farrow et al. (2001) and verified the outcomes acquired there. But after recovery from an acute episode, the research is the first to examine a social cognition paradigm to show enhanced left-medial prefrontal cortex activation in schizophrenia. However, the subjects were predominantly men in this study. Leung and Psych (2000) found that women experience fewer adverse psychosocial consequences of schizophrenia.

DISCUSSION

Farrow et al. (2001), Farrow et al. (2005) and Lee et al. (2006) were the first to examine the relationship between empathy and forgiveness using fMRI. fMRI is needed to further clarify brain mechanisms involved in processing contexts regarding forgiveness and empathic information. The empathy and forgivability judgment paradigms both activated of left superior frontal, orbitofrontal gyri, and precuneus in healthy participants (Farrow et al. 2001), left medial prefrontal cortex activation in patients with schizophrenia (Lee et al. 2006). However, there was no such activation in the PTSD patients (Farrow et al. 2005).

There are some issues to consider in interpreting the results of these studies. *First*, they reported a relationship between empathy and forgiveness of others but not oneself. Macaskill et al. (2002) conducted a research on forgiving one's self and others as well as emotional empathy, but did not apply neuroscientific measures. *Second*, they used a less conservative activation threshold in Lee et al. (2006) with $p<0.005$ and in Farrow et al. (2005) with $p<0.001$, which would increase the number of areas detected. *Third*, The sample size of these studies is low, limiting the generalizability of the research findings; a large sample study can yield important outcomes (Desmond and Glover 2002). *Fourth*, these studies have no control group (Farrow et al. 2001) or treatment group (Farrow et al. 2005; Lee et al. 2006). How important is it that the study results generalize, that is, are interpreted as applying to other people and situations beyond the specific group studied? Such as schizophrenic patients compared with healthy controls for Farrow et al. (2001), might have endorsed the hypothesis that the functional anatomy of empathy is different from that subordinate inference of the intentions of others, and provide a basis for exploring the neural basis of ' dysempathy ' as part of the social cognitive deficits connected with schizophrenia. *Fifth*, the subjects were predominantly male (Leung and Psych 2000) and Caucasian. It means all gender differences must be eliminated and minimize the Other-Race Effect in the near future research. *Finally*, it should also be observed the need to develop social cognition duties for schizophrenia research. Patients with schizophrenia consistently showed underactivation in this area during facial emotion recognition (Quintana et al. 2003). Future studies may want to create functions for assessing various elements of social cognition (for example, perception of facial emotional expressions) in schizophrenia because social cognition is a wide word used to define behavioral mechanisms linked to the perception, comprehension, and execution of language, auditory, visual, and physical indications consisting of various mental and behavioral mechanisms (Suchy and Holdnack 2013).

CONCLUSION

The current literature shows that several of the brain regions activated during social cognition processing using fMRI. For the future growth of new psychological therapies, further knowledge of brain mechanisms in processing environments concerning forgiveness and empathic information is essential. In this paper, we evaluated and summarized the present state of the literature on empathic and forgivability judgments to encourage further study and provide advice on future directions for research as well as further recognition of the studies of neuroscientific methods in the connection between empathy and forgiveness.

ACKNOWLEDGEMENTS

This study received no particular grant from government, commercial or non-profit financing organizations.

REFERENCES

Berry JW, Worthington EL, O'Connor LE, Parrott L, Wade NG 2005. Forgivingness, vengeful rumination, and affective traits. *Journal of Personality,* 73(1): 183-226.

Cohen D, Strayer J 1996. Empathy in conduct-disordered and comparison youth. *Developmental Psychology,* 32(6): 988-998.

Desmond JE, Glover GH 2002. Estimating sample size in functional MRI (fMRI) neuroimaging studies: Statistical power analyses. *Journal of Neuroscience Methods,* 118(2): 115-128.

Egleston PN, Lee KH, Brown WH, Green RD, Farrow TF, Hunter MD, Woodruff PW 2004. Treatment Induced Brain Changes During Forgiveness Tasks in Patients with Schizophrenia. *Paper presented at the 12th Biennial Winter Workshop on Schizophrenia,* Davos, Switzerland, 7-13 February.

Enright R, Freedman S, Rique J 1998. The psychology of interpersonal forgiveness. In: RD Enright, J North (Eds.): *Exploring Forgiveness*. Madison, WI: University of Wisconsin Press, pp. 46-62.

Farrow TF, Hunter MD, Fawbert D, Smith R, Mason S, Gouneea C, Woodruff P 2002. Differential fMRI activations to social reasoning paradigms in patients with PTSD pre-and post-therapy. *NeuroImage HBM2002 CD,* 289.

Farrow TF, Hunter MD, Wilkinson ID, Gouneea C, Fawbert D, Smith R, Woodruff PW 2005. Quantifiable change in functional brain response to empathic and forgivability judgments with resolution of posttraumatic stress disorder. *Psychiatry Research: Neuroimaging,* 140(1): 45-53.

Farrow TF, Zheng Y, Wilkinson ID, Spence SA, Deakin JW, Tarrier N, Woodruff PW 2001. Investigating the functional anatomy of empathy and forgiveness. *Neuroreport,* 12(11): 2433-2438.

Green RD, Lee KH, Brown WH, Egleston PN, Farrow TF, Hunter MD, Woodruff PW 2003. Effect of treatment on brain activation during judgements of forgivability in people with schizophrenia. *NeuroImage,* 19(2): e190.

Hodgson LK, Wertheim EH 2007. Does good emotion management aid forgiving? Multiple dimensions of empathy, emotion management and forgiveness of self and others. *Journal of Social and Personal Relationships,* 24(6): 931-949.

Konstam V, Chernoff M, Deveney S 2001. Toward forgiveness: The role of shame, guilt anger, and empathy. *Counseling and Values,* 46(1): 26-39.

Lee KH, Brown WH, Egleston PN, Green RD, Farrow TF, Hunter MD, Woodruff PW 2006. A functional magnetic resonance imaging study of social cognition in schizophrenia during an acute episode and after recovery. *American Journal of Psychiatry,* 163(11): 1926-1933.

Leung M, Psych CM 2000. Sex differences in schizophrenia, a review of the literature. *Acta Psychiatrica Scandinavica,* 101(401): 3-38.

Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, Moher D 2009. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *PLoS Medicine,* 6(7): 1-28.

Macaskill A, Maltby J, Day L 2002. Forgiveness of self and others and emotional empathy. *The Journal of Social Psychology,* 142(5): 663-665.

McCullough ME 2000. Forgiveness as human strength: Theory, measurement, and links to well-being. *Journal of Social and Clinical Psychology,* 19(1): 43-55.

McCullough ME, Worthington EL, Rachal KC 1997. Interpersonal forgiving in close relationships. *Journal of Personality and Social Psychology,* 73(2): 321-326.

Quintana J, Wong T, Ortiz-Portillo E, Marder SR, Mazziotta JC 2003. Right lateral fusiform gyrus dysfunction during facial information processing in schizophrenia. *Biological Psychiatry,* 53(12): 1099-1112.

Suchy A, Holdnack JA 2013. Assessing Social Cognition Using the ACS for WAIS–IV and WMS–IV. In: J Holdnack, L Drozdick, L Weiss, G Iverson (Eds.): *WAIS-IV, WMS-IV, and ACS Advanced Clinical Interpretation.* San Diego, CA, US: Elsevier Academic Press, pp. 367-406.

Toussaint L, Worthington E, Williams D 2015. *Forgiveness and Health: Scientific Evidence and Theories Relating Forgiveness to Better Health*. Dordrecht, the Netherlands: Springer.

Witvliet CV, Hofelich Mohr AJ, Hinman NG, Knoll RW 2015. Transforming or restraining rumination: The impact of compassionate reappraisal versus emotion suppression on empathy, forgiveness, and affective psychophysiology. *The Journal of Positive Psychology,* 10(3): 248-261.

Worthington E 1998a. An empathy humility commitment model of forgiveness applied within family dyads. *Journal of Family Therapy,* 20(1): 59-76.

Worthington E 1998b. *Empirical Research in Forgiveness: Looking Backward, Looking Forward.* Philadelphia, PA: Templeton Foundation Press.

Zechmeister JS, Romero C 2002. Victim and offender accounts of interpersonal conflict: Autobiographical narratives of forgiveness and unforgiveness. *Journal of Personality and Social Psychology,* 82(4): 675-686.

Paper received for publication in September, 2019
Paper accepted for publication in September, 2019