

BRIEF REPORT

Thanks, but I'm Used to Better: A Relative Rank Model of Gratitude

Alex M. Wood
University of Manchester

Gordon D. A. Brown
University of Warwick

John Maltby
University of Leicester

We argue that more help does not necessarily lead to more gratitude. Rather, gratitude depends on how a given instance of help compares with the help that a person is used to receiving. Participants read vignettes detailing an event in which 11 different friends either lent them varying amounts of money or spent varying amounts of time providing help. The amount of gratitude elicited by a given amount of help (e.g., a loan of £36 [about \$56] or 49 min help) differed substantially depending on how this amount ranked among the help they were getting from their other friends. Comparison across four experimental conditions suggested that these judgments operated via the same general cognitive mechanisms used to judge other social events and psychophysical stimuli (as outlined by range frequency theory). Although more help does lead to more gratitude, people appear to be sensitive to how that help compares with what others are providing, and experienced gratitude depends on these relative judgments.

Keywords: range frequency, theory, rank, emotion, gratitude

Traditionally, gratitude has been considered an emotion that is essential to the operation of social life (A. Smith, 1790/1976). Individual differences in experiencing gratitude are uniquely related to well-being (Wood, Joseph, & Maltby, 2008, 2009), the development of positive relationships (Algoe, Haidt, & Gable, 2008; Wood, Maltby, Gillett, Linley, & Joseph, 2008), greater appreciation of social resources (McCullough, Emmons, & Tsang, 2002; Wood, Maltby, Stewart, & Joseph, 2008), and heightened use of social support coping (Wood, Joseph, & Linley, 2007a). Although such findings have led to gratitude's being conceptualized as an emotion that is essential to social life, relationships, and well-being (Wood, Froh, & Geraghty, in press), gratitude still remains one of the most understudied emotions (McCullough, Kilpatrick, Emmons, & Larson, 2001; Wood, Joseph, & Linley, 2007b), in common with many other positive emotions (Linley, Joseph, Harrington, & Wood, 2006).

Gratitude is an emotion that arises from multiple sources, including (a) general appreciation of other people in one's life, (b) appreciation of nature and the world, (c) a focus on personal benefits and positive circumstances, and (d) aspects of interper-

sonal relationships and transactions (Wood et al., in press; Wood, Maltby, Stewart, Linley, & Joseph, 2008). Gratitude in interpersonal relationships can be toward kind gestures (e.g., providing study breaks), positive responses (e.g., surprise gifts), or the direct provision of aid (Algoe et al., 2008). In this article, we focus on the type of gratitude that emerges after a person has received direct help. This form of gratitude leads to important behavioral outcomes by motivating reciprocation of the aid (Tsang, 2006). This form of gratitude is what Adam Smith (1790/1976) was referring to when he suggested that gratitude is essential to social life because it facilitates social transactions when there are not other legal or economic incentives to behave fairly. Additionally, this form of gratitude has attracted the most attention in the emotion literature, a key assumption of which we aim to challenge in this article.

Previous research into gratitude in response to aid has explicitly or implicitly assumed that (a) the amount of help received causally determines the amount of gratitude experienced in a monotonic fashion and (b) each act of help received is appraised in isolation of other acts of help previously received (see McCullough et al., 2001; Wood, Maltby, Stewart, et al., 2008). In contrast, here we propose the gratitude relativity hypothesis. We suggest that a given act of help is appraised by the receiver relative to the amount of help he or she normally experiences. Moreover, we suggest that a given act of help is compared with other previously encountered acts of help using the same two judgment principles that are used for such psychophysical judgments as evaluating tone, weight, and smell, which are outlined by range frequency theory (RFT; Parducci, 1965).

Rank Principle

Imagine a person is helped by four friends for 5, 10, 15, and 20 min, respectively. The person may be expected to feel a lot of

Alex M. Wood, Department of Psychological Sciences, University of Manchester, Manchester, England; Gordon D. A. Brown, Department of Psychology, University of Warwick, Coventry, England; John Maltby, Department of Psychology, University of Leicester, Leicester, England.

This research was supported by the Economic and Social Research Council (ESRC) grant RES-062-23-2462.

Correspondence concerning this article should be addressed to Dr. Alex M. Wood, School of Psychological Sciences, University of Manchester, 1.18 Coupland Building 1, Oxford Road, Manchester, M13 9PL, England, United Kingdom. E-mail: alex.wood@manchester.ac.uk

gratitude for 15 min of help, partially because it ranks third in the context. The same person may be expected to feel slightly less gratitude for 15 min of help if the four friends had provided 10, 15, 20, and 25 min of help because 15 min now ranks only second in the context. Formally, gratitude for a given act of help should depend on the ordinal position of the help in the context of the help that a person is receiving elsewhere:

$$F_i = (r_i - 1)/(N - 1), \quad (1)$$

where r_i is the ranked position of the stimulus in the context, and N is the number of stimuli in the set. For an account of the psychological processes that underlie this effect, see Stewart, Chater, and Brown (2006).

Range Principle

Imagine that a person receives 20 min of help, either in a context of other friends providing help for between 9 and 63 min or in a context of other friends providing help for between 9 and 22 min. The person may be expected to feel less gratitude in the first case because 20 min is 20% along the overall range of help, whereas in the second case 20 min of help is 85% along the overall range. Formally, this is defined as

$$R_i = (S_i - S_{\min}) / (S_{\max} - S_{\min}), \quad (2)$$

where S_{\min} and S_{\max} are, respectively, the lowest and highest stimuli in the set and S_i is the magnitude of the stimulus i in the context.

RFT suggests that the amount of gratitude that a person would feel for a given act of help would depend on a weighted average between (a) the rank of the help in the context and (b) where the given act falls on the overall range of help in the context. Formally,

$$J_i = wR_i + (1 - w)F_i, \quad (3)$$

where J_i is the overall judgment of stimulus i in the context, and w is an empirically derived weighting function.

Overview

RFT has been shown to provide a good model of how people make complex social judgments, including of other people's psychopathology (Wedell, Parducci, & Lane, 1990), fairness of taxation (Mellers, 1986), fairness of wages (Mellers, 1982), satisfaction with wages (Brown, Gardner, Oswald, & Qian, 2008), happiness after social events (R. H. Smith, Diener, & Wedell, 1989; Wedell & Parducci, 1988), physical attractiveness (Wedell, Parducci, & Geiselman, 1987), body image satisfaction (Wedell, Santoyo, & Pettibone, 2005), student performance (Mellers & Birnbaum, 1983), and likability of another person (Wedell, 1994).

In this article, we provide the first test of (a) whether gratitude for a given act of help depends on the context in which the help is given, (b) whether RFT can explain how these contextual judgments are made, and (c) whether RFT can be applied to emotions. Our approach contrasts with an extensive literature on affective adaptation (for a review, see Wilson & Gilbert, 2008). This literature typically focuses on the time course of the habituation of emotional reactions to experience, partially on the basis of the experience's novelty, unexpectedness, and personal relevance. In

contrast, we focus on how an emotion is appraised relative to a current context of other help being received, suggesting the precise cognitive judgment processes that are used. Specifically, in the present case we hold factors such as novelty, unexpectedness, and personal relevance constant and focus solely on the context of other help received.

Method

Participants

Participants were 158 first- and second-year undergraduates (67.7% female). Ages ranged from 18 to 26 (92.1% younger than 21), and ethnicities were White (77.8%), Indian (14.6%), Black Caribbean (6.3%), and Black African (1.3%). Participation was voluntary and without payment. Participants were tested in small groups, with an experimenter present, and all ratings were made using pencil and paper.

Design and Procedure

Participants were randomly allocated to four groups (38–40 participants per group). All participants read two sets of vignettes, focusing respectively on the contexts of friends providing helping for differing amounts of time and friends lending varying amounts of money. Domains were chosen to be events to which participants could easily relate and also to represent diverse two diverse situations in which people may be helped, to demonstrate the generality of the findings.

In the time vignette, participants were told,

Imagine that you have recently had to take a month off from your course because you have been very unwell. You do not want to retake the year, and believe that you may still be able to catch up. Fortunately, there are 11 other people on the course who are willing to help you understand the material you have missed in lectures, and to help you with your coursework. These people spend varying amounts of time helping you. The time the person spent helping you is listed below. Please consider how grateful you would feel toward each person.

In the money vignette, participants were told,

Imagine you are a recently graduated student. Unfortunately, you have been unable to find a job. Your financial situation is very poor, and you are having trouble paying the bills. Fortunately, you have 11 fellow ex-students as friends, all of whom obtained employment. All of them are on graduate trainee schemes, and all have about the same amount of money to spare as each other. On hearing about your predicament and that you are that having trouble paying the bills, they lend you varying sums of money. The sum of money that each friend has lent you is listed below. Please consider how grateful you would feel toward each friend.

For both vignettes, participants rated how much gratitude they would feel toward each of the 11 friends on a scale ranging from 1 (*not at all grateful*) to 10 (*extremely grateful*). All participants completed both vignettes, and presentation order was fully counterbalanced. The 11 units of time and money that each of the 11 friends provided were varied between the groups as the key experimental manipulation. However, within groups, the same units were used for both vignettes to allow direct comparison of the critical conditions.

Units were presented in the appropriate metric; either minutes or British pounds (at the time of writing, £1 = \$1.65).

Testing the Rank Principle

The unimodal distribution ($n = 38$) and bimodal distribution ($n = 40$) groups were designed to test whether the rank position of a given act of help affected the amount of gratitude the person would feel. The unimodal group received the following units (of time or money, depending on vignette) from their 11 friends: 9, 23, 27, 30, 33, 36, 39, 42, 45, 49, and 63; the bimodal group received 9, 12, 15, 19, 23, 36, 49, 53, 57, 60, and 63. Note that both groups received units ranging from 9 to 63, the average unit was equal between the groups (36), and the groups had three common points in addition to the endpoints (23, 36, and 49).¹ If people's gratitude simply depended on what they received, then each of these common points should elicit equal gratitude between each group. However, if gratitude is rank dependent, the common points should elicit varying amounts of gratitude. For example, £23 (\$37.95) should elicit more gratitude in the bimodal group (in which rank = 5, i.e., it is the fifth most helpful action) than in the unimodal (rank = 2). Thirty-six pounds (\$59.40) should elicit the same gratitude because rank equals 6 for both groups. Forty-nine pounds (\$80.85) should elicit more gratitude in the unimodal group (rank = 10) than in the bimodal group (rank = 7). Note that this implies a cross-over interaction; the unimodal group should experience more gratitude at Point 1 but lower gratitude at Point 3, with the cross-over meeting at Point 2. The same predictions apply for both scenarios. Given that the only differences between the groups involve the rank positions of the acts of help, comparison of these conditions provides a strong test of whether gratitude is sensitive to context as predicted by the gratitude relativity hypothesis.

Testing the Range Principle

The positive ($n = 40$) and negative ($n = 40$) skew groups examined whether overall gratitude toward the group of friends depended on the skew of the help received, as predicted by the range principle. The positive skew group received the following units (again, of time or money, depending on vignette) from their 11 friends: 30, 31, 33, 35, 38, 41, 45, 50, 57, 67, and 84; the negative skew group received 9, 26, 36, 43, 48, 52, 55, 58, 60, 62, and 63. Note that both groups received the same amount of money or time (£511 [\$843.15] or 511 min) and the same average money or time per person (£46.45 [\$76.64] or 46.45 min), and both distributions had a range of 54 (although the negative skew group begins at a lower number, the mean can be equal because the values cluster at the higher end). For both the time and money conditions, the gratitude ratings given to each of the 11 friends were totaled, so that each participant had two single scores representing the total amount of gratitude that he or she felt toward (a) the 11 friends spending time helping him or her and (b) the 11 friends lending him or her money. Because the positive and negative skew groups both received the same overall amount of help, standard accounts predict equal levels of gratitude in each group. However, according to the gratitude relativity hypothesis, greater gratitude should be experienced in the negative skew group because most people providing assistance clustered at the highest end of the range (R. H. Smith et al., 1989; Wedell & Parducci, 1988).

Note that this test is exclusively of range, which is unaffected by the rank principle. Any individual point within the two skewed distributions would be determined by a compromise between range and rank; however, when the ratings given to the 11 people are totaled, any effects of rank are averaged out and can no longer affect the results.

Comparison of the unimodal and bipolar groups tests the rank principle, and comparison of the positive and negative skew groups tests the range principle. More generally, taken together these two comparisons provide a replicated test of whether gratitude for a given act is sensitive to context.

Results

Test of the Rank Principle

Most people reported high levels of gratitude toward their friends for even the smallest amount of help. For example, toward the friend lending the least money (£9 [\$14.85]), on the scale ranging from 1 (*not at all grateful*) to 10 (*extremely grateful*), people reported mean gratitude of 5.13 ($SD = 1.66$) in the unimodal group and 5.45 ($SD = 1.67$) in the bimodal group. (As expected, gratitude did not significantly differ between the groups because in both cases rank = 1, $t[76] = 0.84, p = .40$).

The mean levels of gratitude for the three common points between the unimodal and bimodal groups are presented in Table 1. For both the money and the time vignettes, this table shows the expected differences between the groups; Common Point 1 (23 min or £23) appeared to elicit less gratitude in the unimodal group (where rank = 2) than in the bimodal group (where rank = 5). Conversely, Common Point 3 appeared to elicit more gratitude in the unimodal group (rank = 10) than in the bimodal group (rank = 7). Thus, the same amount of help elicits different amounts of help depending on how it ranks in the context of other helpful acts that a person receives. We tested this interaction with a 2 (between: group) \times 2 (within: vignette) \times 3 (within: common point) mixed-model analysis of variance. As expected, there was a main effect of comparison point, with greater amounts of help eliciting more gratitude, $F(2, 152) = 226.63, p < .001$. There was also the expected interaction between group and comparison point, which was highly significant, $F(2, 78) = 15.53, p < .001$, suggesting that the effect of increasing the amount of help on gratitude depends partially on the rank order of the help in the context of other people's help. There was no main effect of group, vignette domain, Comparison \times Vignette, or Comparison \times Vignette \times Group, suggesting that the results are equally applicable across both lending money and spending time helping. The interaction is graphed in Figure 1.

Test of the Range Principle

We tested whether the amount of gratitude that people felt toward a group of people depended on the skew of the amount of help the

¹ Note that the two groups show no difference in how far each of the common points are from the mean amount of help received (£36 [\$59.40]); thus, any difference in gratitude can only be attributed to differences in the rank of the common points between the groups rather than differences in how far the common points are from the mean (as suggested by rival models of judgment; Helson, 1947).

Table 1
Mean Levels of Gratitude in Both Groups for the Three Common Stimuli

Point		Condition			
		Unimodal (<i>n</i> = 40)		Bimodal (<i>n</i> = 38)	
Critical point	Value	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Lending money					
1	£23	6.55	1.45	7.18	1.26
2	£36	7.55	1.29	7.68	1.16
3	£49	8.47	1.16	8.33	1.02
Time helping					
1	23 min	6.29	1.21	7.00	1.24
2	36 min	7.37	1.05	7.55	1.22
3	49 min	8.32	1.12	8.18	1.13

Note. £23 = \$37.95; £36 = \$59.40; £49 = \$80.85.

people provided, as predicted by the range principle. Total gratitude scores were formed for both the positive and the negative skew conditions, by totaling the gratitude reported toward each of the 11 friends. As expected, for the money vignette, participants reported more gratitude in the negative skew condition ($M = 91.85, SD = 7.93$) than in the positive skew condition ($M = 82.17, SD = 8.78$). Similarly, in the time vignette, participants again reported more gratitude in the negative skew condition ($M = 90.55, SD = 8.72$) than in the positive skew condition ($M = 83.55, SD = 11.29$). A 2 (between: group) \times 2 (within: vignette) mixed-model analysis of variance showed a main effect of group, $F(1, 78) = 23.33, p < .001$; no effect of vignette domain, $F(2, 78) = 0.03, p = .956$; and no Group \times Vignette interaction, $F(2, 78) = 1.22, p < .271$. The results suggest that people reported more gratitude toward the negative skew group (where most help clustered at the top of the range) than toward the positive skew group (where most help clustered at the bottom of the range), even though people received the same overall amount of help from both groups (£511 or 511 min). Moreover, this effect did not change depending on whether the situation involved lending money or time spent helping.

Discussion

The results support the gratitude relativity hypothesis. Gratitude does not simply depend on how much a person is helped but rather

arises from a context-dependent judgment process in which a given instance of help is compared with the other instances of help that a person experiences. RFT provides a good explanation of how these judgments are made, linking gratitude with a growing literature showing that social judgments are always made relative to a previously experienced context and that these judgments use the same general cognitive processes as used to judge psychophysical stimuli.

Future Directions

Several future directions emerge from this research. First, as noted in the introduction, gratitude arises from many sources. Future work needs to test whether RFT can explain situations in which interpersonal gratitude arises (such as after benefits that promote the positive, like surprise gifts, rather than acts that ameliorate the negative, such as the aid considered in this article), as well as other types of gratitude such as one’s perceived position in the world. The current results do not necessarily speak to these possibilities. Moreover, whether the manipulations affected only gratitude or whether other emotions such as indebtedness were also affected needs to be tested.

Second, several studies have noted the importance of appraisals of help in determining gratitude (specifically, interpretations of costliness to provide, value to the recipient, and the altruistic intentions of

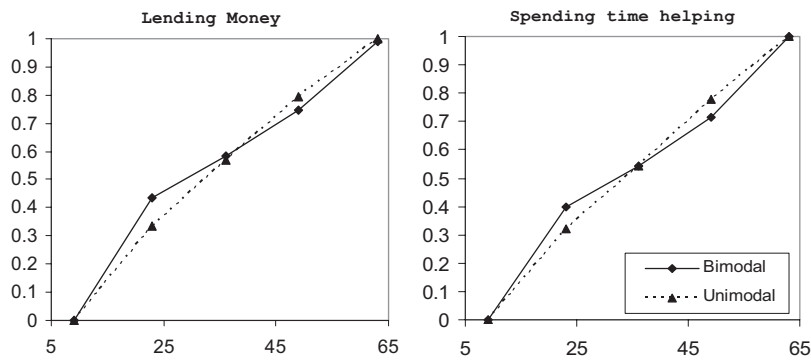


Figure 1. Interactions between condition for the three common stimuli. Following Brown et al., 2008, all participants’ responses were rescaled between 0 and 1 before plotting to remove individual differences in scale use.

the benefactor; see Wood, Maltby, Stewart, et al., 2008). More research is needed into how these appraisals fit in with the current relative account of gratitude; it is likely that these appraisals themselves are relative and may mediate the effects seen in this study.

Third, interventions designed to increase well-being by fostering gratitude have recently been developed, and these interventions have been shown to be as effective as commonly used techniques from cognitive therapy (Geraghty, Wood, & Hyland, 2010, in press). Future interventions could consider examining whether ungrateful people retrieve an inaccurate and maladaptive context of previous help (e.g., habitually retrieving from memory a positively skewed distribution).

Limitations and Conclusions

A key issue with the RFT paradigm is whether the respondents are actively engaging with the task (e.g., actually imagining how much gratitude they would feel) or simply judging the magnitude of the stimulus (e.g., simply rating the amount of money or units of time). In this study, this alternate explanation seems unlikely because people reported moderate (five out of 10) levels of gratitude even for the smallest stimulus (£9 [\$14.85]). This result is consistent with findings that most people feel high levels of gratitude, both in daily life (see Wood et al., in press) and in experimental situations (Wood, Maltby, Stewart, et al., 2008). This result is inconsistent with people simply rating the size of the stimulus, in which case responses should have started at the lowest possible value on the scale. Thus, in this case we have confidence the results represent phenomenological reality, although we do encourage the future use of behavioral outcomes and replication with other methodologies.

This study is the first to suggest that gratitude does not simply arise depending on how much is received but rather depending on how an act of help ranks within the other help that a person receives. More generally, this study is the first to apply RFT to any emotion, which we hope encourages the study of relative judgments in this field. The study of gratitude is still in its infancy, but future work may benefit from considering the emotion as arising from a relative judgment process.

References

- Algoe, S. B., Haidt, J., & Gable, S. L. (2008). Beyond reciprocity: Gratitude and relationships in everyday life. *Emotion, 8*, 425–429.
- Brown, G. D. A., Gardner, J., Oswald, A. J., & Qian, J. (2008). Does wage rank affect employees' well-being? *Industrial Relations, 47*, 355–389.
- Geraghty, A. W. A., Wood, A. M., & Hyland, M. E. (2010). Dissociating the facets of hope: Agency and pathways predict attrition from unguided self-help in opposite directions. *Journal of Research in Personality, 44*, 155–158.
- Geraghty, A. W. A., Wood, A. M., & Hyland, M. E. (2010). Attrition from self-directed interventions: Investigating the relationship between psychological predictors, interventional content and dropout from a body image intervention. *Social Science & Medicine, 71*, 31–37.
- Helson, H. (1947). Adaptation-level as frame of reference for prediction of psychophysical data. *American Journal of Psychology, 60*, 1–29.
- Linley, P. A., Joseph, S., Harrington, S., & Wood, A. M. (2006). Positive psychology: Past, present, and (possible) future. *Journal of Positive Psychology, 1*, 3–16.
- McCullough, M. E., Emmons, R. A., & Tsang, J. A. (2002). The grateful disposition: A conceptual and empirical topography. *Journal of Personality and Social Psychology, 82*, 112–127.
- McCullough, M. E., Kilpatrick, S. D., Emmons, R. A., & Larson, D. B. (2001). Is gratitude a moral affect? *Psychological Bulletin, 127*, 249–266.
- Mellers, B. A. (1982). Equity judgment—A revision of Aristotelian views. *Journal of Experimental Psychology: General, 111*, 242–270.
- Mellers, B. A. (1986). Fair allocations of salaries and taxes. *Journal of Experimental Psychology: Human Perception and Performance, 12*, 80–91.
- Mellers, B. A., & Birnbaum, M. H. (1983). Contextual effects in social judgment. *Journal of Experimental Social Psychology, 19*, 157–171.
- Parducci, A. (1965). Category judgment—A range-frequency model. *Psychological Review, 72*, 407–418.
- Smith, A. (1976). *The theory of moral sentiments* (6th ed.). Indianapolis, IN: Liberty Classics. (Original work published 1790)
- Smith, R. H., Diener, E., & Wedell, D. H. (1989). Intrapersonal and social-comparison determinants of happiness: A range-frequency analysis. *Journal of Personality and Social Psychology, 56*, 317–325.
- Stewart, N., Chater, N., & Brown, G. D. A. (2006). Decision by sampling. *Cognitive Psychology, 53*, 1–26.
- Tsang, J.-A. (2006). Gratitude and prosocial behaviour: An experimental test of gratitude. *Cognition & Emotion, 20*, 138–148.
- Wedell, D. H. (1994). Contextual contrast in evaluative judgments: A test of preintegration versus postintegration models of contrast. *Journal of Personality and Social Psychology, 66*, 1007–1019.
- Wedell, D. H., & Parducci, A. (1988). The category effect in social judgment: Experimental ratings of happiness. *Journal of Personality and Social Psychology, 55*, 341–356.
- Wedell, D. H., Parducci, A., & Geiselman, R. E. (1987). A formal analysis of ratings of physical attractiveness—Successive contrast and simultaneous assimilation. *Journal of Experimental Social Psychology, 23*, 230–249.
- Wedell, D. H., Parducci, A., & Lane, M. (1990). Reducing the dependence of clinical judgment on the immediate context: Effects of number of categories and type of anchors. *Journal of Personality and Social Psychology, 58*, 319–329.
- Wedell, D. H., Santoyo, E. M., & Pettibone, J. C. (2005). The thick and the thin of it: Contextual effects in body perception. *Basic and Applied Social Psychology, 27*, 213–228.
- Wilson, T. D., & Gilbert, D. T. (2008). Explaining away a model of affective adaptation. *Perspectives on Psychological Science, 3*, 370–386.
- Wood, A. M., Froh, J. J., & Geraghty, A. W. A. (2010). Gratitude and well-being: A review and theoretical integration. *Clinical Psychology Review, 30*, 890–905.
- Wood, A. M., Joseph, S., & Linley, P. A. (2007a). Coping style as a psychological resource of grateful people. *Journal of Social and Clinical Psychology, 26*, 1108–1125.
- Wood, A. M., Joseph, S., & Linley, P. A. (2007b). Gratitude: The parent of all virtues. *Psychologist, 20*, 18–21.
- Wood, A. M., Joseph, S., & Maltby, J. (2008). Gratitude uniquely predicts satisfaction with life: Incremental validity above the domains and facets of the five factor model. *Personality and Individual Differences, 45*, 49–54.
- Wood, A. M., Joseph, S., & Maltby, J. (2009). Gratitude predicts psychological well-being above the Big Five facets. *Personality and Individual Differences, 46*, 443–447.
- Wood, A. M., Maltby, J., Gillett, R., Linley, P. A., & Joseph, S. (2008). The role of gratitude in the development of social support, stress, and depression: Two longitudinal studies. *Journal of Research in Personality, 42*, 854–871.

- Wood, A. M., Maltby, J., Stewart, N., & Joseph, S. (2008). Conceptualizing gratitude and appreciation as a unitary personality trait. *Personality and Individual Differences, 44*, 619–630.
- Wood, A. M., Maltby, J., Stewart, N., Linley, P. A., & Joseph, S. (2008). A social-cognitive model of trait and state levels of gratitude. *Emotion, 8*, 281–290.
- Wood, A. M., & Tarrier, N. (2010). Positive clinical psychology: A new vision and strategy for integrated research and practice. *Clinical Psychology Review, 30*, 819–829.

Received August 18, 2009

Revision received June 15, 2010

Accepted September 16, 2010 ■