BASIC AND APPLIED SOCIAL PSYCHOLOGY, *28*(1), 91–100

A Multilevel Analysis of Rumor Transmission: Effects of Anxiety and Belief in Two Field Experiments

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Researchers have generally reported a positive linear relation between rumor anxiety and transmission but less consistent effects of situational anxiety and belief in the rumor. These conclusions, however, are based on relatively few studies that have only analyzed between-subject variance in rumor transmission and often in situations producing only moderate anxiety. We examined rumors stemming from 2 real-world settings: (a) the sudden death of a college student from meningitis and (b) the Washington, DC "sniper" shootings. We analyzed data using multilevel modeling and focused primarily on within-subjects variance. In both studies, we found strong overall effects of belief and typically no overall effect of rumor anxiety. More important, in both studies, a significant Belief × Anxiety interaction occurred. In contrast to past theorizing, the effects of belief were strongest for high-anxiety rumors. Also interesting was a significant curvilinear effect of anxiety at lower levels of belief in Study 1 and a significant main effect of situational anxiety in Study 2. We discuss the important contribution that multilevel modeling can make to the growing literature on rumor transmission.

The study of rumor transmission has a long history in social psychology. Rumors have been shown to affect a variety of domains, including economic stability, national security, and public health (Rosnow, 1991). However, although rumor transmission research began over 70 years ago (Prasad, 1935), relatively few studies have been published in mainstream social psychology journals (see Bordia & DiFonzo, 2002, for an excellent review). Perhaps owing to the perception of rumors as trivial or the difficulty of conducting controlled studies, the paucity of research in this area leaves numerous theoretical questions unanswered. Of particular interest in this article is the level of analysis on which rumors are studied. Prasad (1950) emphasized the need for a "multilevel" approach and suggested that both individual psychological factors and group influences should be examined (see also Guerin, 2001). Virtually all research has examined between-subject variability in the transmission of a single rumor. Our emphasis concerns mainly within-subjects differences in the transmission of multiple rumors.

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WHY ARE RUMORS TRANSMITTED?

Rumors are unconfirmed statements or reports, presented for possible belief (Allport & Postman, 1947; Rosnow, 2001). Four primary factors have been suggested to contribute to the transmission of rumors (Rosnow, 1991). First, rumors arise during uncertain times as people try to make sense of ambiguous situations, particularly when formal channels of information are unavailable (Bordia & DiFonzo, 2004). However, Rosnow (1991) reported only a small effect of uncertainty on transmission across five studies. Because uncertainty is likely to be high in most rumor situations, it may be a better predictor of rumor emergence than transmission rate. Second, the importance of a topic may affect rumor transmission. Allport and Postman (1947) suggested that importance was a necessary condition for transmission. Empirical evidence for its role has been mixed, however, and Rosnow

(1991) suggested that it should be viewed more as a moderator of other factors (e.g., belief).

Our focus in this article is on the two remaining factors predicting rumor transmission: anxiety experienced by the individual hearing the rumor and belief in the rumor, sometimes referred to as credulity.[1] A meta-analysis by Rosnow (1991) suggested both factors are positively related to transmission ($r_{anxiety}$ = .48; r_{belief} = .30). Anxiety increases the need for socialization (Schachter, 1959), and sharing rumors may be one way to meet this need. Spreading rumors that one believes not to be true, however, may bring about negative consequences (rejection from one's social group). These meta-analytic findings are based on relatively few studies, however, and may obscure more complicated relations. For example, Rosnow, Esposito, and Gibney (1988) suggested that the effect of belief may only matter at moderate levels of anxiety. When anxiety is high, a rumor may be transmitted regardless of belief, and when anxiety is low, belief may be insufficient to motivate its transmission. Although intriguing, interactions between belief and anxiety have yet to be reliably demonstrated.

THREE TYPES OF ANXIETY

Rosnow (1980) defined anxiety as "a negative affective state that is produced by apprehension about an impending, potentially negative outcome" (p. 587). Complicating matters, however, is the fact that researchers have examined three different types of anxiety:

1. *Situational anxiety:* Some situations produce more anxiety than others (e.g., murder on campus vs. potential tuition increase).
2. *Rumor-specific anxiety:* Some topics evoke more anxiety than others ("murderer is loose" vs. "murderer was caught").
3. *Trait anxiety:* Some individuals are chronically more anxious than others.

Rosnow's (1991) meta-analytic procedure does not appear to distinguish between these forms of anxiety.

Studies using these three forms of anxiety offer mixed results. Anthony and colleagues (e.g., Anthony, 1973; Anthony & Gibbons, 1995; Jaeger, Anthony, & Rosnow, 1980) found that high trait anxiety is associated with greater transmission. Walker and Beckerle (1987) showed that manipulated increases in situational anxiety led to greater transmission, but they found no effect of rumor-specific anxiety. Similarly, Esposito (1987) found that situational anxiety, but not rumor anxiety, predicted rumors concerning a mass transit strike. In contrast, rumor anxiety, but not situational anxiety, predicted transmission of a rumor concerning a college murderer (Rosnow et al., 1988). Finally, Kimmel and Keefer (1991) found that both situational and rumor anxiety predicted number of people told but that only rumor anxiety emerged as a unique predictor of transmission in a stepwise regression.

Curvilinear Effects of Anxiety

Rosnow (1980) hypothesized that trait anxiety might have a curvilinear (inverted-U) relation with rumor transmission. Extremely anxious people may be so distressed that meaningful conversations with others are difficult, and those experiencing minimal anxiety may not find enough interest in the rumor to transmit it (but see also Guerin, 2001). Although intriguing, we are unaware of any research that has reported such a curvilinear relationship. Why? First, levels of anxiety that have been described in many studies are not particularly high. Thinking that another student has been expelled or that funding for one's club might be cut will cause anxiety but probably not at the level envisioned by Rosnow. Second, even when anxiety is high, most studies have not directly tested for curvilinear effects. Finally, although Rosnow theorized about trait anxiety, the curvilinear effect seems more applicable to anxiety produced by a specific rumor. Even people who are not chronically anxious may still find themselves so upset by the contents of a particular rumor that they feel unable or unwilling to mention it to others. Thus, if curvilinear effects do exist, they might obtain only when using measures of rumor-specific anxiety.

BELIEF IN A RUMOR

As with anxiety, the effects of belief on transmission are mixed. Prasad (1935, 1950) noted that even implausible rumors are sometimes transmitted. Similarly, Esposito (1987) found that initial belief did not uniquely predict transmission of rumors about a public transit strike. However, when Jaeger et al. (1980) manipulated believability by having a second person confirm a planted rumor, transmission significantly increased. Additionally, Rosnow, Yost, and Esposito (1986) found that belief strongly predicted transmission of rumors concerning a volatile labor negotiation. Interesting, Rosnow et al. (1988) suggested that the effects of belief may be moderated by anxiety. They found that initial belief in rumors about a campus murderer predicted transmission rates[2] and that this effect was greatest when rumor anxiety was moderate, although the curvilinear trend

[1] *Credulity* is defined as "a disposition to believe too readily" with synonyms of *gullibility* and *naiveté* (Pickett et al., 2000). Although early researchers appear to have had such a definition in mind (e.g., Prasad, 1950), modern researchers are more concerned with the plausibility of a rumor or the extent of one's belief in it.

[2] Although "number of people told" was measured by Rosnow et al. (1988), all findings were reported as a dichotomous (yes/no) measure of transmission.

was not significant. Similarly, Kimmel and Keefer (1991) found that initial belief was significantly correlated with transmission of rumors about AIDS, although it did not remain after controlling for rumor anxiety and uncertainty. Nonetheless, 64% of participants in the Kimmel and Keefer study who did not transmit a rumor cited disbelief as their primary reason. This echoes Prasad (1935), who felt that belief in a rumor was not so much a conviction but rather a lack of opposition to what is heard. Unfortunately, Kimmel and Keefer did not test anxiety as a moderator of the effects of belief.

THE NEED FOR MULTILEVEL MODELING

In many field studies, participants have reported hearing multiple rumors. Treating each rumor as an independent event during analysis can invalidate significance tests and obscure the relations we discussed previously. To address this nonindependence problem, Rosnow et al. (1988) and Esposito (1987) have examined only the first rumor listed by each of their participants, ignoring remaining rumors. Kimmel and Keefer (1991) instead aggregated responses to multiple rumors to create a single response per participant. Unfortunately, these approaches have sacrificed statistical power and ignored within-subjects variability, which may account for a large proportion of the total variability in rumor transmission.

Instead, we employed multilevel modeling (Bryk & Raudenbush, 2002; Reise & Duan, 2003).[3] In both studies, at Level 1 (within-subjects), we created a separate regression equation for each participant predicting transmission of each rumor from rumor anxiety and belief. In Study 2, we included situational anxiety for each individual as a Level-2 (between-subject) predictor of the average transmission rate. We also included cross-level interactions between situational anxiety and anxiety and belief as we explain in the Method section. Besides allowing analysis of multiple rumors without violating nonindependence assumptions, multilevel modeling typically provides more stable regression coefficients and more accurate standard error estimates than would be obtained by traditional ordinary least squares (OLS) approach (see Beckstead, 2003).

OVERVIEW

We examined the transmission of rumors following two important and uncertain real-world events. In Study 1, we examined rumors immediately following the death of a college student who died unexpectedly from meningitis. In Study 2, we examined rumors transmitted during the Washington, DC sniper shootings in 2002. In both cases, the rumors evoked a wide range of anxiety and belief. Because our multilevel approach is novel, previous research may not be directly comparable. As a general guide, however, it leads us to predict a large effect of anxiety and a medium effect of belief. Previous theorizing has also suggested that belief may not matter at high levels of anxiety and also that anxiety may show a curvilinear effect such that very high or low anxiety reduces transmission. Thus, we examined transmission rates in the following ways: (a) We compared the relative contributions of between-subject and within-subjects variability to the total variability in rumor transmission; (b) we examined the relative linear contribution of rumor anxiety, belief, and their interaction at the within-subjects level; (c) we tested for curvilinear effects of rumor anxiety at the within-subjects level; and (d) we tested for linear effects of situational anxiety at the between-subject level and its possible moderating effects on other linear variables.

STUDY 1: STUDENT DEATH RUMORS

Method

Participants. Of introductory psychology students, 105 (51% female) at Wake Forest University (population = 3,500) received extra credit for participating in a study ostensibly examining "how people react to and discuss tragedies." Care was taken to explain that those who knew the deceased or otherwise felt uncomfortable were not required to participate. Two students declined to participate. Four students reported hearing no rumors, and 3 did not provide complete information. There were 96 remaining participants.

Materials and procedure. We asked participants to list every rumor they had heard concerning the recent and unexpected death of a male college student from bacterial meningitis. Following the death, a university memo was circulated to all students informing anyone who had close contact with the student to come to Student Health Services to receive a preventative antibiotic. Rumors emerged within hours after his death and continued past the following week when we collected data. Rumor content included speculation about the cause of death, contagiousness, symptoms, treatment of the disease, and personal information about the victim. We asked participants to indicate for each rumor (a) "What is the total number of people you told?," (b) "How anxious did this particular rumor make you feel when you heard it?" (on a 7-point scale ranging from 1 = *not at all* to 7 = *extremely*), and (c) "How strongly did you believe this rumor when you first heard it? (on a 7-point scale ranging

[3]Multilevel modeling is a generic term. Hierarchical linear modeling, or HLM, is a brand name for a copyrighted product (HLM 5.05, © 2001) that many people (ourselves included) use to perform multilevel analyses. Because other products also exist (e.g., SPSS, R/S-Plus) to perform such analyses, the generic term is preferable.

TABLE 1
Level-1 Analysis of Rumor Transmission Predictors in Study 1 (Student Death Rumors)

Predictor	*Unstandardized Coefficient* γ	*SE*	*Standardized Coefficient* γ´	*p*
Intercept	4.25	.37		.001
Belief	0.68	.13	.21	.001
Anxiety	0.20	.17	.06	.224
Anxiety^2	–0.15	.10	–.08	.132
Belief × anxiety	0.29	.13	.13	.029
Belief × anxiety	0.10	.05	.10	.030

Note. $R^2 = .63$. Approximate *df* for tests of fixed effects = 94.

from 1 = *not at all* to 7 = *completely*). All responses were anonymous.

RESULTS

Preliminary Analyses

All predictor and dependent variables were tested for multivariate outliers using Mahalanobis distances, resulting in the elimination of 9 rumors and 1 participant. The remaining 95 participants listed a combined total of 308 rumors, with a mean of 3.2 rumors per individual (median [*Mdn*] = 3, range = 1–10 rumors). Approximately 85% of the rumors were transmitted at least once, and only 6 participants did not transmit any rumors. A typical rumor was transmitted to 4.4 people (*SD* = 4.2). Rumors were rated, overall, as moderately credible (*M* = 5.3, *SD* = 1.3), with very few students hearing any rumors that they completely disbelieved. Mean rumor anxiety ratings were near the midpoint of the scale (*M* = 4.3, *SD* = 1.3). The correlations between anxiety and belief were .27 and .23 at Level 1 and Level 2, respectively.

Multilevel Modeling

At Level 1, we modeled within-subjects variability in transmission of different rumors by the same individual. This produced a separate regression equation for each participant. Note the inclusion of a quadratic component to test for curvilinear effects of anxiety as well as terms representing the interactions of anxiety with belief:

$$Y_{ij} = \beta_{0j} + \beta_{1j}\,(\text{belief})_{ij} + \beta_{2j}\,(\text{anxiety})_{ij} + \beta_{3j}\,(\text{anxiety}^2)_{ij} + \beta_{4j}\,(b \times a)_{ij} + \beta_{5j}\,(b \times a^2)_{ij} + r_{ij},$$

where Y_{ij} is the number of times the *i*th rumor reported by the *j*th individual is transmitted; β_{0j} is the mean number of people told averaged over all rumors reported by the *j*th individual[4]; the coefficients β_{1j}, β_{2j}, β_{3j}, β_{4j}, and β_{5j} represent the effects of belief, anxiety, anxiety^2, and the linear by linear and linear by quadratic interactions, respectively; and r_{ij} represents random error.

At Level 2, we modeled the β coefficients as having both a fixed (γ) and a random component (μ), respectively:

$$\begin{aligned}\beta_{0j} &= \gamma_{00} + \mu_{0j}\\ \beta_{1j} &= \gamma_{10} + \mu_{1j}\\ \beta_{2j} &= \gamma_{20} + \mu_{2j}\\ \beta_{3j} &= \gamma_{30} + \mu_{3j}\\ \beta_{4j} &= \gamma_{40} + \mu_{4j}\\ \beta_{5j} &= \gamma_{50} + \mu_{5j}\end{aligned}$$

The γ coefficients represented the average of the Level-1 (β) coefficients across all individuals and may be interpreted as unstandardized regression coefficients. Unlike OLS regression, this model allowed the intercept and the effects of the predictors to vary from individual to individual. The μ coefficients represented this variance in Level-1 coefficients over all individuals. Such variance occurred for two reasons: (a) the number of rumors reported differed across participants and (b) the slope of the relations modeled at Level 1 (belief, anxiety, etc.) differed somewhat across participants.

Approximately 57% of the total variance in transmission was associated with between-subject differences. The remaining 43% represented pooled within-subjects differences, which is the target of all remaining analyses.

The combined effects of belief, anxiety, anxiety^2, and their interactions (see Table 1) accounted for 63.0% of the pooled variance in transmission. With belief and rumor anxiety held constant at their respective means, rumors were transmitted to a mean of 4.25 people. There was a strong effect of belief but neither a linear nor a quadratic effect of anxiety. However, both of these terms significantly interacted with belief, and thus, we kept them in the model to ensure accurate interaction term estimates. A linear interaction indicated that the effect of belief was stronger at high (+1 *SD*) levels of anxiety (slope = 1.20, $p < .001$) than at low (–1 *SD*) levels of anxiety (slope = 0.49, $p = .02$). A quadratic interaction indicated that the effects of anxiety became curvilinear as belief decreased. At low levels of belief, rumors producing moderate anxiety were transmitted more than those producing either very high or very low levels of anxiety (see Figure 1).

[4]This interpretation of the intercept follows from mean-centering each predictor.

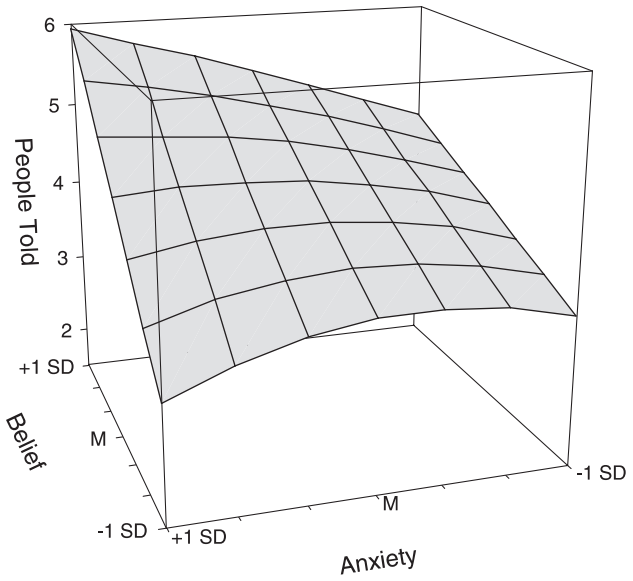

FIGURE 1 Interactive effects of belief and rumor anxiety on transmission (Study 1). Effects of belief are strongest at high levels of anxiety. At low levels of belief, anxiety has a curvilinear effect. All effects are within-subjects. Figure is rotated to obtain the best viewable angle; this reverses the axis representing rumor anxiety.

DISCUSSION

Belief in Rumor

In this study, as belief in a rumor increased so did its transmission rate. This finding was qualified, however, by a significant interaction with rumor anxiety (see Figure 1) that indicated that the effects of belief occurred primarily for high-anxiety rumors. Why? The hesitancy to transmit an upsetting but implausible rumor is consistent with the admonition not to "cry wolf" (Rosnow, 1991). However, an upsetting but believable rumor may be transmitted because it is adaptive to inform others, particularly friends, of impending danger (Weenig, Groenenboom, & Wilke, 2001). Another possibility is that people transmit rumors not merely to inform but also to elicit information from others (e.g., Bordia & DiFonzo, 2004). For example, one rumor claimed that everyone exposed to the infected student must receive a painful "spinal tap." A student who believed this might transmit it to obtain more information about the procedure or about what constitutes "exposure" to the infected student.

Rumor Anxiety

With belief held constant at its mean, anxiety was unrelated to transmission rate. As rumors became more believable, anxiety began to have a positive (linear) effect on transmission. As belief decreased, however, the effects of anxiety became increasingly curvilinear (see Figure 1). Implausible rumors were transmitted to more people when they produced moderate rather than high or low levels of anxiety. To our knowledge, this is the first empirical demonstration of a curvilinear effect of anxiety on rumor transmission. Our findings qualify Rosnow's (1980) prediction by suggesting that it may only occur for rumors that are not strongly believed. As mentioned earlier, norms against transmitting anxiety-provoking rumors should be strongest when such rumors are thought to be untrue. Rumors producing little anxiety may simply not be worth mentioning to others if they are not believed. Recall that Rosnow conceptualized anxiety as an individual trait, whereas we measured differences in anxiety associated with each rumor. The distinction may not matter, however, because people with high trait anxiety tend to experience high levels of state anxiety (Harrigan, Wilson, & Rosenthal, 2004).

Situational Anxiety

In addition to rumor-specific anxiety used in this study, some researchers (Esposito, 1987; Kimmel & Keefer, 1991; Rosnow et al., 1988) have measured an overall situational anxiety. Although none have found it to be a significant predictor using a traditional OLS approach, multilevel analysis offers an alternative for testing its influence. In Study 2, we modeled situational anxiety as a Level-2 (between-subject) predictor of rumor transmission and also as a cross-level moderator of the Level-1 (within-subjects) factor. We sought to replicate the effects of rumor belief and rumor anxiety in Study 1 as well as test for linear and moderating effects of situational anxiety.

STUDY 2: WASHINGTON, DC SNIPER RUMORS

Method

Participants. A total of 208 psychology students (65% female) at the University of Virginia received course credit for participating. In the 3 weeks prior to data collection, a series of random shootings took place in the Washington, DC, "beltway" area. Ten people were killed, each by single shot from a high-powered rifle. Most of our data collection took place the day after John Allen Muhammed and Lee Malvo were captured (October 24, 2002). The University of Virginia (population = 13,000) is located in Charlottesville, Virginia, approximately 90 miles from Washington, DC. Although no sniper-related violence occurred in Charlottesville, both local residents and students were concerned that shootings were possible (Altamirano, 2002). Further, many students had friends and relatives in the Washington, DC, area. Thus, we felt confident that many students would recall moderate to high levels of anxiety. Of the 208 participants, 16 reported hearing no rumors and 5 did not provide complete information on the rumors they heard. Data from 187 participants remained.

Materials and procedure. In an anonymous questionnaire, given at the end of class, the participants were first asked about situational anxiety: "Overall, how anxious have you felt about the sniper shootings during the past few weeks?" rated on a 7-point scale ranging from 1 (*not at all*) to 7 (*extremely*). Next, participants listed up to five rumors they heard concerning the sniper shootings. Participants were encouraged to list both bad and good things, regardless of whether the rumor had ultimately been proven true or false, and that it was okay if they had heard the rumor on the news.[5] Rumor content included speculation about who was being targeted, where the next shooting would occur, the vehicle used by the sniper, whether or not the sniper had actually been caught, and personal information about the victims. Participants were then asked to indicate how many people they told each rumor. Next, they were asked "How did this rumor make you feel when you heard it?" rated on a 7-point scale ranging from 1 (*very relaxed*) to 7 (*very anxious*), and "Did you believe the rumor when you heard it?" rated on a 7-point scale ranging from 1 (*definitely no*) to 7 (*definitely yes*). As in Study 1, all responses were anonymous.

RESULTS

Preliminary Analysis

Testing for multivariate outliers using Mahalanobis distances resulted in the elimination of 23 rumors and 1 participant. The remaining 186 participants listed a total of 718 rumors (M = 4.0 each, Mdn = 5, range = 1–5). Approximately 78% of the rumors were transmitted at least once, and only 17 of the participants (9.5%) did not transmit any rumors. On average, each rumor was transmitted to 3.2 people (SD = 3.0). As in Study 1, the average rumor was moderately believable (M = 5.0, SD = 1.7), and very few students heard rumors they completely disbelieved. Rumors were moderately anxiety producing (M = 4.4, SD = 1.7). The overall situational anxiety regarding the sniper shootings was also moderate (M = 3.9, SD = 1.6). The correlations between rumor-specific anxiety and belief were .29 and .36 at Level 1 and Level 2, respectively.

Multilevel Modeling

This study employed the same Level-1 model used in Study 1:

$$Y_{ij} = \beta_{0j} + \beta_{1j}\,(\text{belief})_{ij} + \beta_{2j}\,(\text{anxiety})_{ij} + \beta_{3j}\,(\text{anxiety}^2)_{ij} + \beta_{4j}\,(b \times a)_{ij} + \beta_{5j}\,(b \times a^2)_{ij} + r_{ij}.$$

[5]Because the media often report rumors (Oberlechner & Hocking, 2004; Shales, 2002), we were concerned that excluding events that participants heard or thought they had heard on the news would unnecessarily limit the number of rumors they reported.

At Level 2, situational anxiety was included as a between-subject predictor of transmission and as moderator of rumor anxiety and belief:

$$\begin{aligned}
\beta_{0j} &= \gamma_{00} + \gamma_{01}(\text{situational anxiety}) + \mu_{0j}\\
\beta_{1j} &= \gamma_{10} + \gamma_{11}(\text{situational anxiety}) + \mu_{1j}\\
\beta_{2j} &= \gamma_{20} + \gamma_{21}(\text{situational anxiety}) + \mu_{2j}\\
\beta_{3j} &= \gamma_{30} + \mu_{3j}\\
\beta_{4j} &= \gamma_{40} + \mu_{4j}\\
\beta_{5j} &= \gamma_{50} + \mu_{5j}
\end{aligned}$$

The additional coefficients, γ_{01}, γ_{11}, and γ_{21} represented the effects of situational anxiety on the intercept (measuring between-subject effects), the belief coefficient, and the rumor anxiety coefficient, respectively. During early analyses, however, we found situational anxiety to have no significant moderating effect on belief, and we removed this term (γ_{11}) from the model. As in Study 1, level-1 predictors were centered within each individual and level-2 predictors were grandmean-centered. Approximately 48% of the variance in number of people told was due to between-subject differences; the remaining 52% was pooled within-subjects variance.

In the analyses following, we modeled pooled within-subjects variance as in Study 1, but we modeled between-subject variance as a function of situational anxiety. Results are shown in Table 2. The intercept indicated that 3.19 people, on average, were told a rumor when anxiety, belief, and situational anxiety were held constant at their respective means. The quadratic effect of rumor anxiety and the linear by quadratic interaction between belief and rumor anxiety were not significant and we dropped them from the final equation. The main effect of rumor anxiety was not significant, but we left this in the model to accurately assess the linear interaction between belief and anxiety. As in Study 1, belief had a stronger effect for high-anxiety (+1 SD) rumors (slope = .55, $p < .001$) than for low-anxiety (–1 SD) rumors (slope = .20, $p = .05$). At Level 1, 23% of the within-subjects variance in people told was explained by belief and the Belief × Rumor Anxiety interaction.

Situational anxiety significantly predicted between-subject differences in transmission, explaining 21% of this variance. Situational anxiety also moderated the effects of rumor anxiety. For people experiencing average (M) or low (–1 SD) situational anxiety, rumor anxiety was unrelated to transmission (slopes = 0.06 and –0.13, respectively, both ps > .1). However, for those reporting high (+1 SD) situational anxiety, the effect of rumor anxiety was significant and positive (slope = 0.25, $p = .02$). The moderating role of situational anxiety accounted for 18% of the variation in Level-1 regression slopes. This cross-level interaction can be seen in Figure 2.

TABLE 2
Multilevel Analysis of Rumor Transmission Predictors in Study 2 (Sniper Rumors)

Model	*Predictor*	*Unstandardized Coefficient γ*	*SE*	*Standardized Coefficient γ´*	*p*	R^2
Level-1						.231
	Intercept	3.19	.16		.001	
	Belief	0.37	.08	.16	.001	
	Anxiety	0.06	.07	.03	.360	
	Belief × anxiety	0.14	.06	.08	.013	
Level-2						
	Situational anxiety	0.57	.09	.31	.001	.209
	Situational anxiety × anxiety[a]	0.12	.04	.49	.002	.179

Note. R^2 is proportion of level-specific variance explained.
[a]This term represents a cross-level interaction; coefficients and R^2 values reflect the effects of individual differences in situational anxiety on the Level-1 coefficients associated with rumor anxiety. Approximate *df* for tests of fixed effects = 184.

DISCUSSION

Belief and Anxiety

As in Study 1, a main effect of belief on transmission emerged. More important, this effect was qualified by a significant Belief × Rumor anxiety interaction (see Figure 2). Collapsing across situational anxiety (which did not moderate the effects of belief), the strongest effects of belief occurred for high-anxiety rumors. Such rumors were transmitted considerably more when they were believed than when they were not. Belief had relatively little effect, however, for low-anxiety rumors.

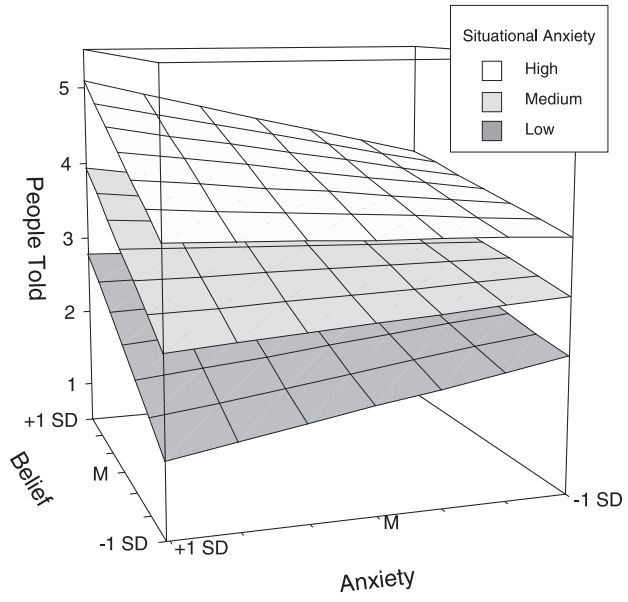

FIGURE 2 Interactive effects of belief and rumor anxiety, and situational anxiety on transmission (Study 2). Effects of belief are strongest when situational anxiety is high. Belief and rumor anxiety are within-subjects effects; situational anxiety is a between-subject effect. Figure is rotated to obtain the best viewable angle.

Of course, this interaction could also be interpreted as belief moderating the effects of rumor anxiety. When rumors were not believed, rumor anxiety had little effect. However, when rumors were believed, rumor anxiety was positively associated with transmission. Regardless, and as in Study 1, the overall effect of rumor anxiety was not significant when belief was held constant at its mean.

Situational Anxiety

The largest main effect in Study 2 was situational anxiety (see standardized coefficients in Table 2). Participants who were very anxious about the sniper shootings in general transmitted rumors to many more people than those who were not anxious. Although our finding is consistent with research manipulating situational anxiety (Walker & Beckerle, 1987), to our knowledge, this is the first observational study to show effects of situational anxiety after controlling for belief and rumor anxiety.

We also found that situational anxiety moderates the effects of rumor anxiety. That is, the effect of rumor anxiety on transmission of different rumors was only significant for participants reporting high situational anxiety. At low levels of situational anxiety, rumor anxiety did not matter. This is puzzling because we would assume (and parsimony would dictate) that both sources of anxiety combine to produce a single phenomenological experience in people. Separate sources of anxiety should have additive effects, but we would not typically expect one source to moderate the effects of the other. One possibility is that our measure of situational anxiety also taps into the degree of importance the situation has for participants. A student who is not worried that the sniper will affect her life in any important way may not be sufficiently motivated to transmit a rumor even if it concerns a particularly anxious topic. Past research has confirmed that relevance or importance can affect rumor transmission (Allport & Postman, 1947; Rosnow, 1991).

GENERAL DISCUSSION

In this article, we used multilevel modeling to examine rumor transmission. In two studies, almost 89% of our participants heard multiple rumors, and approximately 50% of the total variance in the transmission of these rumors was due to systematic within-subjects differences. Had we limited our analysis to only one rumor per person (as many previous studies have done), such variance would have been present but confounded with between-person variability. Of course, because our findings focus primarily on within-persons variability, these findings may not be directly comparable to past research.

Anxiety

Past studies (using single-level analyses) have usually reported that rumor anxiety but not situational anxiety best predicts rumor transmission (e.g., Esposito, 1987). Our multilevel data indicate the opposite. Rumor anxiety alone did not significantly predict variability in transmission of different rumors heard by the same person, but situational anxiety strongly predicted individual differences in mean transmission rates. Past research may have suffered from restricted ranges of situational anxiety. Although few researchers have provided detailed statistics, Esposito (1987) reported that overall anxiety levels in his research were generally low, and Kimmel and Keefer (1991) reported that situational anxiety was very high, thus suggesting the possibility of floor and ceiling effects, respectively.[6] In contrast, the mean situational anxiety in our Study 2 was approximately at the center of the 7-point scale, with a sizable standard deviation.

Particularly unusual was the fact that situational anxiety moderated the effects of rumor anxiety. Although never particularly strong, the effects of rumor anxiety on transmission did increase with increases in situational anxiety. Although speculative, this finding may reflect the possibility that our measure of situational anxiety indicates how important or relevant the topic is for participants (Rosnow, 1991). Future researchers may thus wish to examine more directly the possible moderating effects of importance on rumor anxiety.

Curvilinear Effects

We found curvilinear effects of rumor anxiety in Study 1 (student death) but not in Study 2 (sniper). Earlier, we suggested that motives to transmit rumors to avoid harm may have been stronger for participants in the latter study. Although the overall level of anxiety was comparable in both studies, the sniper was believed by some to have been targeting people in certain groups or certain locations. Thus, rumor transmission could be used to elicit important information about how to avoid such a threat. In contrast, the bacterial illness in Study 1 posed a more hidden, less "discriminating" danger, which people may have considered unavoidable. Admittedly, the curvilinear effects we obtained in Study 1 were strongest with relatively unbelievable rumors for which transmission rates were already rather low. Thus, future researchers who seek curvilinear relations for anxiety should do so with belief in the rumor in mind.

Belief

Early researchers (e.g., Prasad, 1950) have generally dismissed the effects of belief and noted that even extremely implausible rumors are sometimes transmitted. More recently, Rosnow's (1991) meta-analysis found a modest overall effect of belief, but primarily based on bivariate relations that either did not control for anxiety (e.g., Rosnow et al., 1986) or that disappeared after doing so (Esposito, 1987; Kimmel & Keefer, 1991). Our research here found strong effects of belief, even after controlling for multiple forms of anxiety.

Belief × Rumor Anxiety

more important, both studies found that the effects of belief strengthened as rumor anxiety increased. Previous researchers (Kimmel & Keefer, 1991; Rosnow et al., 1988) have hypothesized an interaction between anxiety and belief but have suggested that the effects of belief should be strongest at moderate levels of anxiety. Although we found smaller effects of belief at the lowest levels of anxiety, belief exerted its greatest influence at highest levels of anxiety. The interaction could explain why some studies (e.g., Esposito, 1986) have found relatively small effects of belief—they may have examined only low-anxiety rumors. Further, although rumor anxiety clearly magnified the effects of belief, situational anxiety had no moderating effect at all. Although it is certainly possible that we did not tap into the highest levels of situational anxiety, the threats of a highly contagious fatal disease and an equally fatal, unpredictable sniper would seem to represent as much anxiety as exists in most real-world settings. If the mitigating effect of situational anxiety on belief can only be observed by creating artificially extreme scenarios, it is probably of little import to researchers.

Limitations

One important limitation of virtually all field research on rumor transmission is that neither belief nor anxiety were experimentally manipulated, making causality impossible to ascertain. Thus, belief and transmission may be related because a person who transmitted a rumor to many people wishes to appear consistent when asked about his belief in the rumor (Rosnow et al., 1986). To reduce this possibility, we asked participants to report belief "when they first heard"

[6]Rosnow et al. (1988) did not report the overall level of situational anxiety in their study, although given the nature of the rumors (murder on campus), we can assume that it was relatively high.

the rumor, and we also informed participants via both written and oral instructions that their responses were anonymous, that there were no right or wrong answers, and that they could feel comfortable responding "completely honestly." Although this still does not rule out the possibility that rumors are sometimes transmitted as a rhetorical or conversational ploy (Guerin, 1994, 2003), Rosnow (1980, 2001) has argued that people are unlikely to frequently transmit rumors they privately consider untrustworthy because doing so would undermine their own status (see also Silk, Kaldor, & Boyd, 2000; and Stevens & Fiske, 1995). This would seem to be particularly true in situations of grave importance such as reported here. Finally, we note that our findings are consistent with a study (Jaeger et al., 1980) that manipulated belief and that also showed that participants' verbal reports of belief were consistent with the experimental manipulation.

Future Research

We have presented a multilevel approach to studying rumor transmission that is applicable in both field and experimental settings. Our findings point to the need for greater attention to both within-subjects predictors and to cross-level moderators. One potential moderator is distrust. Allport and Postman (1947) suggested that "rumor will race when individuals distrust the news that reaches them" (p. 3). Such a prediction could be analyzed by testing whether individual differences in distrust at Level 2 moderate the effects of belief on rumor transmission at Level 1 (cf. DiFonzo, Bordia, & Winterkorn, 2003). Other moderators of belief may include positive or negative attitudes toward the value of rumor and gossip (Litman & Pezzo, 2005). Clearly, these findings offer multiple directions for further research and more important, a powerful method of analysis through which to pursue them.

ACNKOWLEDGMENTS

Portions of this research were presented at a symposium entitled "Rumor & Gossip: Recent Theory and Research" at the 4th annual meeting of Society for Personality and Social Psychology, Los Angeles, CA, February 2003. This research was partially funded by a New Investigator Research Grant (University of South Florida St. Petersburg) to M. V. Pezzo.

We thank Stephanie Parks Pezzo, Nick DiFonzo, and John Yost for their helpful comments on earlier versions of this article. We are also grateful to Rachel Kaplan for her assistance in Study 1 and to Holly Hom for collecting the data in Study 2.

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