APPLIED COGNITIVE PSYCHOLOGY
Appl. Cognit. Psychol. **24**: 1034–1045 (2010)
Published online 20 August 2009 in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/acp.1604

Social Anxiety Moderates Memory Conformity in Adolescents

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SUMMARY

When two people view the same event and later try to remember it together, what one person says affects what the other person reports. A model is presented which predicts that this memory conformity effect will be moderated, in different ways, by two components of social anxiety. People with higher fear of negative evaluation should be more influenced by their peers than others, but those with higher social anxiety related to avoiding social situations may be less influenced by their peers than others. Pairs of adolescent-aged participants took part in a face recognition study. For each trial one person responded and then the next person responded. The effect of what the first person said on the second person's response was measured; the size of the effect was moderated by the social anxiety measures as predicted by the model. This is the first study showing the relationship between social anxiety and memory suggestibility. Copyright © 2009 John Wiley & Sons, Ltd.

For over 30 years, research showing that postevent information (PEI) can be incorporated into people's subsequent memories of an event has been applied to errors in an eyewitness context (Loftus, 2005). The findings have been influential in establishing methods for interviewing eyewitnesses (Fisher & Geiselman, 1992) and are part of much expert testimony about the reliability of memory (Loftus, 1979, 1986). Most of the research has involved the PEI being embedded in biased questions or false narratives. However, there is another way in which people encounter PEI. Surveys of real eyewitnesses show that they often receive PEI from other eyewitnesses (Paterson & Kemp, 2006b; Skagerberg and Wright, 2008c). Because of this, several groups have conducted research where the PEI is delivered by another person (e.g. Candel, Memon, & Al-Harazi, 2007; Cuc, Ozuru, Manier, & Hirst, 2006; French, Garry, & Mori, 2008; Gabbert, Memon, & Wright, 2007; Hope, Ost, Gabbert, Healey, & Lenton, 2008; Mori, 2007; Ost, Ghonouei, Cook, & Vrij, 2008; Paterson & Kemp, 2006a; Principe & Ceci, 2002; Reysen, 2005; Skagerberg & Wright, 2008a,b; for a review see Wright, Memon, Skagerberg, & Gabbert, 2009). This type of memory suggestibility is called memory conformity or social contagion of memory (Roediger, Meade, & Bergman, 2001). The goal of this study was to examine whether social anxiety moderates memory conformity among adolescents.

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For several reasons, adolescents are an important group in which to study the moderating effects of social anxiety on memory conformity. Adolescents consistently are among the most common victims and witnesses to participate in the legal system (U.S. Bureau of Justice Statistics, 2007) yet there is little research to guide forensic practice with adolescents. Memory conformity is a particularly interesting paradigm to use with adolescents since this developmental period is when individuals are highly susceptible to peer influence (e.g. Berndt, 1982; Costanzo & Shaw, 1966). However, the influence of peers on adolescents' memory reports has not yet been examined. Adolescence is also the most common age of onset for social anxiety (Rapee & Spence, 2004; Weems & Costa, 2005), and social anxiety affects interactions with peers (La Greca & Lopez, 1998). Therefore, we reasoned this age group would allow adequate response variability on our memory conformity and social anxiety measures. Below, we first present our basic model of memory conformity followed by a discussion of how social anxiety is expected to moderate the memory conformity effects.

A MODEL OF MEMORY CONFORMITY

Social psychologists often differentiate two reasons why people conform to others. These are informational and normative processes (Deutsch & Gerard, 1955; see also Kelman, 1958). In this section we examine how these processes may operate within a model of memory conformity.

One process that can lead people to conform is trusting the other person's memory more than their own memory. This is informational influence and involves combining beliefs from different sources. People conform for informational reasons when the other person is more confident or when one expects the other person to have a better memory. For example, Wright, Self, and Justice (2000, Exp. 2) showed pairs of participants a set of photographs of a crime. One person in the pair saw the culprit with an accomplice and the other saw the culprit act on her own. Immediately after seeing these photographs participants took a memory test on their own. The test included a question about whether there was an accomplice. Participants also rated their confidence. The pairs were asked to discuss the event and in every pair the existence of an accomplice was mentioned. The people in each pair were separated and asked individually whether there was an accomplice. In 75% of the pairs one of the people had changed their belief to coincide with the other's belief. In almost every case the less confident person in the pair accepted the more confident person's memory.

Another study demonstrating informational influence is by Gabbert, Memon, and Wright (2007). Pairs of participants arrived at the laboratory and were shown several pictures of busy scenes. Half of the participants were told that they viewed the scenes for half as long as the other person and half of the participants were told that they viewed the scenes for twice as long. The participants who thought that they viewed the scenes for less time should think that the other person in the pair has a better memory (all other things being equal). After viewing the scenes participants discussed the scenes together, and were then tested individually. The participants who thought they viewed the scenes for less time showed higher levels of conformity than those who thought they viewed the scenes for longer.

People also conform for normative reasons, which involve individuals comparing the costs of disagreeing with the costs of making an error. When talking with the other

DOI: 10.1002/acp

co-witnesses an eyewitness may not want to disagree with them. There is a social cost associated with disagreeing with others. For example, disagreeing with a romantic partner can carry a high cost. If the costs of making an error are low then people would often agree with the other people if the costs of disagreeing are relatively high. This is why some of the participants in Asch's (1955) conformity studies knowingly gave the wrong answer. Baron, Vandello, and Brunsman (1996, Experiment 1) conducted a study where they manipulated the cost of an error. They presented participants either with a simple or with a difficult identification task. Consider their simple task where participants got to see the culprit and the line-up pictures for several seconds. In the control condition participants were accurate 97% of the time, so empirically the task was easy. Participants in the experimental conditions were faced with a confederate who provided an incorrect response. When participants were told that these data would be used by police and courts, and that the most accurate participants would be given a monetary prize, only 16% of responses conformed. However, when they were told the data would just be used as pilot data 33% conformed. Participants in Baron et al. were reconciling the costs of disagreeing with the other person with the costs of making an error. When the costs of making an error were low, there were twice as many conforming responses.

Figure 1 shows our model of informational and normative influences applied to memory conformity. People combine beliefs of their own with other people's beliefs. There are arrows back from the combined belief to the originals, which allows, for example, people to think someone who always gives a different answer than them has a poor memory. The cost of disagreeing and the cost of making an error are combined to create a payoff matrix for the value of each response. The believed probability of any response being accurate can be multiplied by the appropriate value in the payoff matrix and the person gives the response with the highest utility. While formal mathematical models can be created for this model

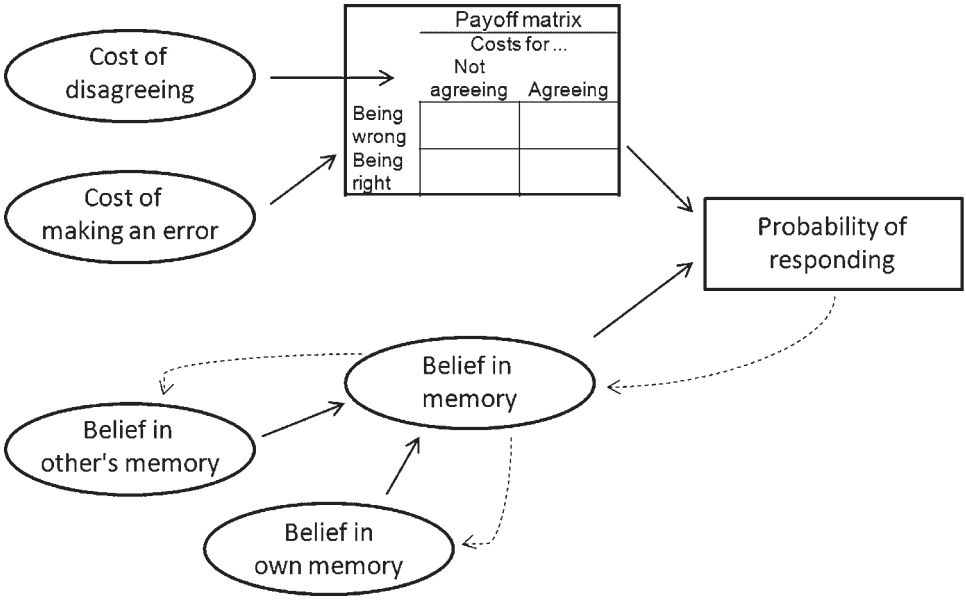

Figure 1. Normative and informational influences model of memory conformity. According to the model people combine their beliefs with others and consider the costs of disagreeing and the costs of making an error

DOI: 10.1002/acp

(and are currently being tested), the focus here is on which individual difference measures should predict memory conformity. Before describing these measures, it is important to stress that the social psychological processes outlined in our model are inter-related to aspects of the belief (i.e. is the belief a recollective memory, is it a false memory, etc.), that memorial processes must be considered (e.g. that people believe their own memories for an event more than they believe their lack of memories for an event), and that the memory conformity procedures can produce false recollective memories (Roediger et al., 2001).

WHY LEVELS OF SOCIAL ANXIETY MAY RELATE TO MEMORY CONFORMITY

Understanding individual differences in performance is important for understanding any cognitive task. From Figure 1 we predict that if people vary in how important it is to agree with others then this should be positively associated with memory conformity. Our model also predicts that some people may be more attuned to information from others in a social setting. This should affect how people combine their belief with the beliefs of others. Our literature search led us to examine social anxiety.

Historically the concept of social anxiety has been associated with many different labels: Stage fright, social phobia, social withdraw, shyness, introversion, etc. Early versions of the DSM (pre-IV) distinguished social avoidance disorder from social phobia, and while later versions offer many different diagnosis (Kearney, 2005), the research literature continues to find two main components of social anxiety. Consider research on the psychometric properties of one of the main social anxiety self-report scales: The *Social Anxiety Scale for Children* (La Greca, Dandes, Wick, Shaw, & Stone, 1988). With various versions of this scale, researchers consistently show different components of social anxiety for fear of negative evaluation and social avoidance.

The *fear of negative evaluation* component maps onto having a high cost of disagreeing. The model in Figure 1 predicts somebody will knowingly give an errant response if the cost of disagreeing is higher than the cost of being wrong. Thus, if certain people have a higher cost of disagreeing, Figure 1 predicts that they will agree with the other person more than if they have a lower cost of disagreeing.

Figure 1 also predicts that if somebody does not process social information well then they may show less memory conformity. This is because when combining their belief with others, they should pay less attention to information presented from the other person. A second component of social anxiety, called *social avoidance*, may relate to this. The prediction is that people who score high on social avoidance will have lower amounts of memory conformity than people who score high. This second prediction is more tentative because people who avoid social information may still weigh it highly when combining beliefs.

We predict that these two components of social anxiety will be associated with memory suggestibility in different ways. Scores on fear of negative evaluation will be positively associated with memory conformity while social avoidance may be negatively associated with memory conformity. La Greca et al. (1988) and others find these components tend to be positively correlated with each other, so predicting that they will be related to memory conformity in opposite directions is important.

Our target population is adolescents and we use a social anxiety scale specifically designed for adolescents (La Greca and Lopez' [1998] *Social Anxiety Scale for*

DOI: 10.1002/acp

Adolescents, SAS-A). There has been a recent upsurge in adolescence research on memorial processes (Melnyk & London, 2009), social information processing (Blakemore & Choudhury, 2006) and the behavioural consequences (Morgan & Banerjee, 2006). Adolescence is a time when there is much variation in social anxiety so we reasoned this was the ideal age period to look for the relationship between social anxiety components and memory conformity.

MEMORY CONFORMITY METHODS

Three approaches have used to examine memory conformity. First, some researchers have shown small groups of participants an event sequence, had the participants discuss the event, and then examined how each participant's memory was affected by what the other people said during the discussion (e.g. Gabbert, Memon, & Wright, 2006). The second approach is to show participants an event sequence and then provide participants with false information about how other participants performed (e.g. Shaw, Garvin, & Wood, 1997; Skagerberg & Wright, 2009). Both of these approaches can be used to construct situations similar to those involving some eyewitnesses (e.g. showing participants a simulated robbery). However, it is difficult to have more than a couple of discrepant items in the discussion and therefore it is difficult to estimate individual differences in suggestibility unless the expected effect is very large.

The third approach is to present participants with a large number of stimuli and then to test people in small groups where the participant can hear or see other people's responses (e.g. see Allan & Gabbert, 2008; Meade & Roediger, 2002; Schneider & Watkins, 1996; Wright, Mathews, & Skagerberg, 2005). The stimuli are sets of simple unrelated items. Researchers have used words, photographs of faces and photographs of objects. This recognition memory procedure produces a large amount of data for each participant. As the number of stimuli increases so does the reliability of the estimates for memory conformity and therefore this procedure is appropriate for exploring potential moderators of the memory conformity effect. Thus, we use a social recognition memory procedure to test whether the components of social anxiety are associated with memory conformity in a manner consistent with the model in Figure 1. This is the first study examining the relationship between social anxiety and memory suggestibility.

METHODS

Ninety eight participants were recruited in pairs from local schools and YMCAs in Toledo, US, area. Twelve were dropped because of having more than one missing item on the personality measures. Of the remaining 86 participants, 32 were male. They were between 11 and 18 years old with a mean of 14.72 years ($SD = 1.54$ years). No age trends were found in these data.

Participants were given La Greca and Lopez' (1998) *Social Anxiety Scale for Adolescents* (SAS-A), which is adapted from their child social anxiety scale. The SAS-A is a widely used scale specifically designed to measure social anxiety in adolescents. The SAS-A is a self-administered pen and paper questionnaire composed of 22 items where participants respond on 1–5 scales for how often they feel each statement applies to them. Participants were tested individually. La Greca and Lopez found that the items loaded on

DOI: 10.1002/acp

three correlated (rs $> .5$) factors: Fear of negative evaluation (FNE), social avoidance and distress to new situations (SAD-New) and social avoidance and distress generally (SAD-General). They found Cronbach's αs of .91, .83 and .76 for these subscales.

Next, a face recognition memory procedure was conducted as follows. Participants were tested in pairs. They sat approximately 1 m from a computer screen and were shown 50 white male faces one at a time for 2 seconds each with no time between faces (stimuli from Wright, Gabbert, Memon, & London, 2008, Experiment 2). To prevent confounding differences among face stimuli with differences among participants, all pairs saw the same set of faces. Next, the experimenter explained they were going to take part in a memory recognition procedure. They were shown a response sheet with two columns. The first column was for the first participant to place their response and the second column was for the second participant. Each column contained 100 rows, with boxes marked 'old' and 'new' on which participants were instructed to mark their responses for each of the 100 faces. They were told that they would see the same 50 photographs interspersed with 50 new photographs and that they should say whether they think the face had been shown before ('old') or not ('new'). During testing, a face was shown on the screen, the first person marked 'old' or 'new', and handed the response sheet to the second person to mark their response. After the second person responded they handed the sheet back to the first person who pressed RETURN on the computer and the next face was shown. This continued for all 100 faces. All participants indicated that they understood the instructions. The experimenter was present throughout to ensure this procedure was followed.

Participants were randomly allocated either always to respond first or always to respond second. Those responding first provide a baseline for accuracy and are the control group. Primary interest is with those responding second: The PEI group. For any of the 100 trials the PEI participants can be in one of four conditions of a 2×2 within-subject design. The first factor is whether the face was previously shown (old) or not (new). The second is whether the other person said 'old' or 'new'. These factors are correlated because the first person tends to respond accurately, therefore there are not 25 trials per cell per person.[1] The dependent variable is whether the participant says 'old' or 'new'.

RESULTS

A single missing value on SAS-A was replaced using the missing values procedure in SPSS (EM algorithm). Subscales were calculated and standardized so each subscale had a mean of 0 and a standard deviation of 1. Their reliabilities were: FNE (Cronbach's $\alpha = .88$, 95% CI = [.84, .92]); SAD-new (Cronbach's $\alpha = .86$, 95% CI = [.81, .90]); and SAD-general (Cronbach's $\alpha = .67$, 95% CI = [.54, .77]). The Cronbach's αs reported by La Greca and Lopez (1998) are all within our observed confidence limits. These SAS-A subscales were correlated among themselves between .56 and .64, which are also approximately the same as those La Greca and Lopez (1998) report.

For the 43 participants who responded first (i.e. the control group), only six of the 4300 trials had missing values (0.1%). They responded 'old' for 28.9% of new faces (i.e. 'false alarms') and for 59.9% of old faces (i.e. 'hits'). One popular measure of accuracy is the *logit*. This is the natural logarithm of the ratio of the odds of saying 'old' when the face

[1]Some research uses a confederate for responding first (e.g. Wright et al., 2008). A confederate was not used in the current research because it would have been impractical to have confederates of similar ages to the participants.

DOI: 10.1002/acp

is old over the odds of saying 'old' when the face is new. Zero corresponds to chance responding so values above zero show memory. If the variables are scaled properly then the population logit is estimated by the coefficient in a multilevel logistic regression (Wright, Horry, & Skagerberg, 2009; and appendix for details of this approach). For the control group the estimate is: 1.51, se = 0.18, $p < .001$, indicating they performed significantly above chance in accuracy.

For the 43 participants who responded second (i.e. the PEI group), 12 of the 4300 trials (0.3%) were missing due to participants not ticking 'new' or 'old', or responding after the first person did not tick one of these. Analyses are based on the remaining 4288 trials. Table 1 shows the responses broken down by whether the face was old or new and what the first participant said. The memory effect is evident because people said 'old' more to old faces than to new faces, both when the first participant said 'old' and when the first participant said 'new'. The memory conformity effect is evident because people said 'old' more if the other person said 'old' than if the other person said 'new', both for faces that were old and those that were new.

Multilevel logistic regressions were used for inferential statistics. The PEI participant's response was the dependent variable. We allowed the intercept to vary for both participants and faces and allowed the coefficient for accuracy to vary by participant. The units for all the β values we report are logits, though for graphing the data we use the probability of responding 'old'. The memory accuracy effect, $\beta = 1.45$, se = 0.18, $p < .001$, and the memory conformity effect, $\beta = 1.05$, se = .08, $p < .001$, are both much larger than zero. The interaction between what the other person said and whether the face was old or new was statistically significant, likelihood ratio $\chi^2(1) = 5.50$, $p = .02$. The conformity effect was larger for new faces, $\beta = 1.26$, than for old faces, $\beta = .90$, replicating Wright et al. (2005).

Next, moderator analyses were conducted to see if any of the social anxiety components moderated the size of the conformity effect. We used a stepwise approach to search for moderator variables. The main effect of each social anxiety component and its interaction with what the other person said were included in the model. We searched for the component with the largest interaction. Because stepwise procedures involve many statistical tests, we required $p < .01$ for including an effect. The interaction between SAS FNE and what the other person said had the largest interaction, $\chi^2(1) = 15.78$, $p < .001$. As predicted, FNE was positively associated with memory conformity. Neither of the other two components had significant interactions at this stage, but we then introduced them into regressions including FNE and its interaction. The SAD-new subscale interaction had the larger improvement, $\chi^2(1) = 10.78$, $p = .001$. As predicted, social avoidance was negatively associated with memory conformity. After including the effects for SAD-new, the interaction between SAD-G and what the first person said was non-significant, $\chi^2(1) = 0.57$, $p = .45$.

Table 1. The frequency and percentage of trials with 'old' responses from the participant responding second when the first person says 'new' or 'old', and when the face is new or old

	First person says:		
	New	Old	Row mean
New faces	257/1526 = 16.8%	306/621 = 49.3%	563/2147 = 26.2%
Old faces	398/859 = 46.3%	908/1282 = 70.8%	1306/2141 = 61.0%
Column mean	655/2385 = 27.5%	1214/1903 = 63.8%	1869/4288 = 43.6%

DOI: 10.1002/acp

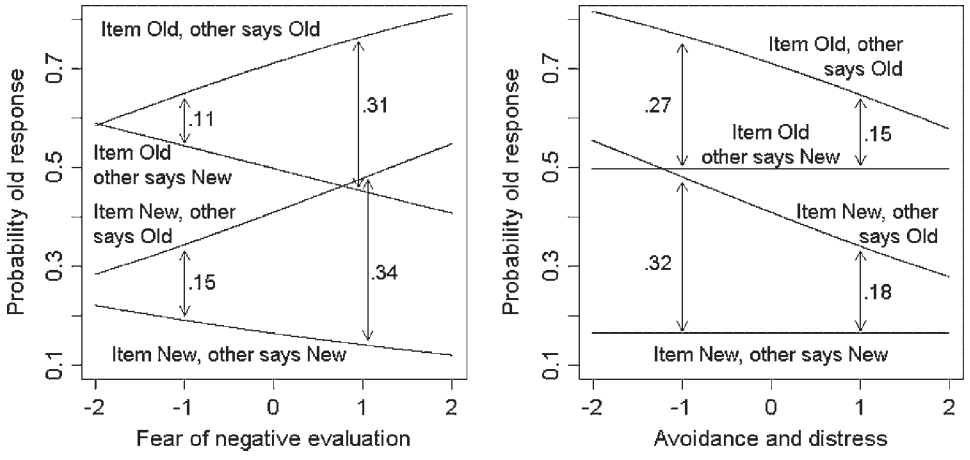

Figure 2. The probabilities of 'old' responses for the FNE and SAD-new subscales of the SAS-A (La Greca & Lopez, 1998). These probabilities are while holding the values of the other subscale constant at 0

Figure 2 shows the final model including the interactions of FNE and SAS-new. The predicted probabilities for responding 'old' are shown, broken down by whether the face was old or new and what the first person said for different values of the two statistically significant social anxiety components holding the value of the other component fixed at 0. These social anxiety variables are standardized, so 0 is the mean of the sample and values of -1 and $+1$ are one standard deviation below and above the means for these variables. For FNE, the conformity effect (i.e. the difference between the other person saying 'old' and 'new') is about 13% for people scoring one standard deviation below the mean while it is about 32% for those scoring one standard deviation above the mean. For SAD-new the effect is about 30% for those scoring one standard deviation below the mean and 17% for those scoring one standard deviation above the mean.

DISCUSSION

This study is the first to show a relationship between social anxiety and memory suggestibility. Most relevant research has differentiated at least two components of social anxiety. We predicted that the two main components would moderate the memory conformity effect, but in opposite directions. We hypothesized that people who think the cost of disagreeing is higher than the cost of making an error would be likely to conform in memory conformity tasks (Figure 1). In the social anxiety literature, the Fear of Negative Evaluation subscale of La Greca and Lopez' SAS-A (1998) measures individual difference in the cost of disagreeing. As we predicted, FNE scores were positively correlated with memory conformity (left panel of Figure 2). A shift from one standard deviation below the mean to one standard deviation above the mean is associated with approximately doubling the size of the memory conformity effect.

Figure 1 also shows that how people combine information from other people and from themselves is important for memory conformity. If someone avoids information from others they should not be susceptible to memory conformity. We thought that people who score high on social avoidance might not process information from other people well. We

DOI: 10.1002/acp

predicted that people with higher scores might show less memory conformity. La Greca and Lopez' SAS-A has two subscales that correspond to this type of social anxiety. The avoidance of new situations subscale was negatively correlated with memory conformity after controlling for fear of negative evaluation. The right panel of Figure 2 suggests the influence is about half the size for people one standard deviation above the mean compared with people one standard deviation below the mean. Because this effect was only found after controlling for FNE and that the effect was observed for only one of the two social avoidance subscales further research is necessary before any definitive conclusions are reached.

In summary, remembering in social situations is a complex task and the current research shows how individual differences in social anxiety are associated with memory conformity among adolescents. To understand the relationship it is necessary to differentiate these types of social anxiety. People who are social avoidant are less influenced, in general, by other people and we show that they also appear less influenced by their memory reports. People who fear negative evaluation are more likely to coalesce with others' memory reports to avoid negative appraisal. The literature on individual differences and PEI is small and in the past has focused on cognitive measures (e.g. Bruck & Melnyk, 2004; Read & Winograd, 1998). Further testing is needed to examine whether the moderating effects of social anxiety on memory conformity extend to other age groups and with other measures of social anxiety. The memory conformity procedures are arguably a more ecologically valid way to examine memory suggestibility than traditional individual tasks because memory conformity tasks are embedded in the social situation in which the suggestion occurs. Here we show personality variables related to social encounters should be considered when examining memory suggestibility.

ACKNOWLEDGEMENTS

This study was funded by the British Academy to DBW and KL. The authors thank Daniella Villalba, the editor, and the reviewers for comments on the previous draft.

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APPENDIX

For any individual trial the participant can say 'old' or 'new'. The probability of them saying 'old' should increase if they were previously shown the face, provided their memory is above chance. The probability of them saying 'old' should increase if the other person says 'old' (and should decrease if the other person says 'new'), provided they exhibit at least some memory conformity. The probability of an 'old' response will vary among participants and among the faces. We also expect there to be differences among participants for how good their memories are. Following Clark (1973), the aim is to allow random effects for both participants and stimuli. Recent computing advances allow these random effects to be modelled relatively easily with the following multilevel logistic regression (Baayen, Davidson, & Bates, 2008; Goldstein, 2003; Wright & London, 2009):

$$\ln\left(\frac{\Pr(\text{response}_{ijk}=\text{old})}{1-\Pr(\text{response}_{ijk}=\text{old})}\right)=\beta 0_{jk}+\beta 1_j\text{seen}_{ijk}+\beta 2\,\text{othersays}_{ijk}$$

Let response_{ijk} be the ith trial for the jth person to the kth face. The $\beta 0_{jk}$ is the intercept and it relates to the response criterion in signal detection theory terminology. It includes the subscripts j and k. This means it has different values for each participant and each face. We

DOI: 10.1002/acp

assume there is some grand mean, $\beta 0$, and that values for participants will be normally distributed around this value with some unknown standard deviation to be estimated. Similarly, values for faces are also assumed to be normally distributed around $\beta 0$.

$\beta 1_j$ is related to accuracy. It has the subscript j meaning that the values vary by participant. We assume that these values are normally distributed around $\beta 1$. $\beta 2$ is the parameter that measures conformity. The higher the value is, the greater the conformity is. We examine variation in the size of this effect by the social anxiety measures.

On the basis of past research (e.g. Wright et al., 2005) we expect that there will be large effects for memory ($\beta 1 >> 0$) and for conformity ($\beta 2 >> 0$). Our interest is whether the conformity effect is moderated by the components of social anxiety. 'Moderator analysis' is the phrase used in much social and health psychology when exploring if an effect of one variable depends on the level of another variable. In statistics terminology this is an interaction. To test if a component of social anxiety moderates the conformity effect we first include the main effect of the component, and then test whether adding the interaction between the component and the coefficient for conformity improves the fit of the model. Because of the number of tests, we decided beforehand to set $\alpha = .01$ rather than .05, but for these data none of the observed p values were between these levels.

Multilevel generalized linear models are currently fit with methods that approximate maximum likelihood. The Laplace method is used. This is the default for the package lme4 (Bates, Maechler, & Dai, 2008), which was used. It is part of the software R (R Development Core Team, 2008) and is available for free from the Comprehensive R Archive Network.

DOI: 10.1002/acp