Sub-types of nonbelieved memories reveal differential outcomes of challenges to memories

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Abstract

Nonbelieved memories (NBMs) highlight the independence between distinct metamemorial judgments that contribute to the experience of remembering. Initial definitions of NBMs portrayed them as involving the withdrawal of belief in occurrence despite sustained recollection. While people rate belief for their NBMs as weaker than recollection, the average difference is too small to support the idea that autobiographical belief is completely withdrawn in all cases. Furthermore, autobiographical belief and recollection ratings vary considerably across NBMs. In two studies, we reanalyzed data from prior studies to examine whether NBM reports reflect a single category or multiple sub-categories using cluster analytic methods. In Study 1, we identified three sub-types of NBMs. In Study 2 we incorporated the concept of belief in accuracy, and found that two of the clusters from Study 1 split into two clusters apiece. All clusters were characterized by higher recollection than belief in occurrence ratings, and clusters were differentiated by the degree of difference between these variables. In both studies the clusters were discriminated by a number of memory characteristic ratings and by reasons reported as leading to the alteration of belief. Implications for understanding the remembering of past events and predicting the creation of NBMs are discussed.

Keywords: nonbelieved memory, subtype, cluster analysis, belief in occurrence, accuracy, memory

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Nonbelieved memories (NBMs) have been described as a counterintuitive phenomenon in which a person claims to have a vivid episodic recollection of an event, despite no longer believing that the event is veridical. Anecdotal reports of NBMs have been known for some time, but this type of memorial experience has only recently become a topic of scientific study, and recognized as more common than previously thought (Mazzoni, Scoboria, & Harvey, 2010; see Otgaar, Scoboria, & Mazzoni, 2014, for a review). The purpose of this paper is to revisit the quality of fit between people's reports and ratings of naturally-occurring NBMs and theoretical characterizations of these memories. To this end, we examine the possibility that differentiating sub-types of NBMs might better elucidate the circumstances in which people's appraisals of belief in occurrence and recollection about remembered events are revised.

Researchers interested in NBMs have found them relatively easy to observe in everyday experience, and easy to create artificially in the laboratory. As a consequence, several studies have been conducted that collectively reveal some typical characteristics of NBMs. First, when people report having ceased believing a memory, this belief-change frequently follows the receipt of some form of social feedback (in about half of reports; Scoboria, Boucher, & Mazzoni, 2015). Individuals also report altering belief due to reappraisal of the plausibility of events, attributing events to a source other than memory, internal recollective characteristics (e.g, a memory is "fuzzy"), external details (e.g., photographs), general metacognitive beliefs about remembering, attributions about the self or others, and personal motivations to alter belief. Second, the phenomenological characteristics of NBMs are in many ways similar to those associated with (believed) episodic recollection (Johnson, Foley, Suengas, & Raye, 1988; Rubin, Schrauf, & Greenberg, 2003). For instance, in both survey-based and laboratory studies,

participants rate believed and nonbelieved memories similarly with respect to their perceptual detail, spatial detail, and the sense of re-experiencing the past (Clark, Nash, Fincham, & Mazzoni, 2012; Mazzoni, Clark, & Nash, 2014; Otgaar, Scoboria, & Smeets, 2013; Scoboria et al., 2014; Scoboria & Talarico, 2013; Scoboria & Pascal, in press). However, in some studies participants have judged their NBMs to have less narrative coherence than do their believed memories, and to be less connected within memory networks, less personally important, and to signify less-plausible events. Recognizing the existence and characteristics of NBMs has provided strong evidence on which to advance novel arguments about an important theoretical distinction in autobiographical remembering: between *recollection* on the one hand, and *belief in occurrence* on the other. Before elaborating a rationale for considering sub-types of NBM, we will first pause to define and briefly discuss these key dimensions of the investigation.

Recollection

Recollection involves mentally reinstating the perceptual, temporal, or spatial characteristics of past experiences, and combining this mental simulation with a sense of re-experiencing the past (Brewer, 1996; Tulving, 1983). See Rubin and Umanath (2015) for a related view on the nature of mental simulation. It is this combination of mental simulation and recapitulation that is unique to episodic recollection (Addis, Pan, Vu, Laiser, & Schacter, 2009), and so mental simulations not accompanied by a sense of re-experiencing tend instead to be attributed to other sources of mental experience, such as imagination (Johnson, Hashtroudi, & Lindsay, 1993). Recollection judgments are therefore metacognitive appraisals of certain qualities that may be associated with mental representations, but importantly, are just one of a number of metacognitive judgments that contribute to the experience of remembering the past (Rubin, 2006; Scoboria et al., 2014).

Belief in occurrence (Autobiographical belief)

A second metacognitive judgment implicated in remembering the past is belief in occurrence: a broad judgment that an event genuinely occurred to the self in the past. These judgments are typically made with reference to the evidence that is available (Scoboria et al., 2014), and are therefore highly sensitive to the retrieval context, in particular social feedback (Clark et al., 2012; Mazzoni, Loftus, Seitz, & Lynn, 1999; Scoboria, Lynn, Hessen, & Fisico, 2007; Scoboria, Wysman, & Otgaar, 2012). Belief in occurrence judgments are much more responsive to social feedback than are recollection judgments, which serves as one piece of evidence that the two must be rooted in distinct underlying processes (Mazzoni et al., 2014; Scoboria et al., 2014).

Prior to the growth of research on NBMs, it was commonly thought that belief in occurrence was a necessary but not sufficient precondition for recollection – that is, people should not always need to recollect events in order to believe those events occurred, yet they should always need to believe the events occurred in order to recollect them (Scoboria, Mazzoni, Kirsch, & Relyea, 2004). To the contrary, the existence of NBMs demonstrates that these two metacognitive judgments are in fact distinct and fully dissociable, a proposition that has since been empirically verified (Scoboria et al., 2014). Despite this dissociability, though, it is noteworthy that the experience of recollection may still influence belief in occurrence considerably, as it is likely that people often infer belief in occurrence from the strength of recollection (Scoboria et al., 2004).

How 'nonbelieved' and 'memory-like' are nonbelieved memories?

Mazzoni et al. (2010) described NBMs as "vivid autobiographical memories for events that people no longer believe happened to them" (p. 1334). Similarly, Scoboria et al.'s (2014)

discussion of NBMs included phrases such as "stopped believing" and "withdrawal of belief" (p. 3). If these descriptions are correct, then participants who appraise their NBMs should reliably provide high ratings of recollection and low ratings of belief in occurrence. The empirical evidence is not clearly in line with this assertion. In Scoboria et al. (2014), participants' average recollection ratings for naturally-occurring NBMs were reliably higher than their belief in occurrence ratings; yet their recollection ratings were not at the scale ceiling ($M \sim 5.2$ on the 7-point scale), nor were their belief in occurrence ratings at the scale floor ($M \sim 3.5$). In contrast, when participants appraised believed memories, their recollection ratings were close to the scale ceiling, reliably higher than their recollection ratings for NBMs. These findings were replicated in the two studies reported by Scoboria and Pascal (in press).

Thus believed and nonbelieved memories may differ after all in terms of recollection, not just in terms of belief in occurrence. Indeed, in experimental lab studies where participants receive disconfirming social feedback about their memories, this feedback reduces not just participants' ratings of belief in occurrence, but also to a lesser extent their ratings of recollection. These findings necessitate some softening in the characterization of NBMs. For example, Scoboria, Talarico, and Pascal (2015) more conservatively defined NBMs as instances in which "the strength of recollection exceeds that of autobiographical belief" (p. 338). Furthermore, these findings also raise the possibility that research on NBMs to date may in fact have captured very few NBMs that meet Mazzoni et al.'s (2010) definition, whereby recollection is strong but belief in occurrence is weak. If this were the case, then one possible implication could be that this kind of NBM is actually rare, as was previously thought to be the case.

Whereas previous research has focused generally on characterizing average NBMs, no research has looked closely at the variability between NBMs. Scoboria (2013) proposed that

when people encounter evidence that contradicts vivid memories, different outcomes can occur: sometimes belief is completely relinquished, sometimes belief is partially reduced, and sometimes belief is not altered at all. The data from lab studies concur with this proposal insofar that disconfirming evidence does not always lead people to fully, or even partially, abandon belief in occurrence (Clark et al., 2012; Mazzoni et al., 2014). Moreover, there is ample evidence outside the lab that people sometimes 'defend' memory claims in spite of contrary evidence. Sheen, Kemp, and Rubin (2001), for instance, discuss cases in which identical twins each claim that a remembered experience happened to themselves and not to the other sibling.

Hence it is entirely unsurprising to discover variability in the extent to which challenges affect belief in events' occurrence. Indeed, the same variability emerges in lab studies where researchers have used suggestion to create false beliefs and memories. In those studies, participants do not believe the target event occurred to them at the start of the procedure. In response to suggestive procedures, some participants come to show substantial increases in belief ratings, while others show small increases in belief ratings, and others show no increases at all (Mazzoni, Loftus, & Kirsch, 2001; Scoboria, Lynn, Hessen, & Fisico, 2007; Scoboria, Mazzoni, Jarry, & Shapero, 2012). Some of the earliest studies on the formation of rich false memories took the view that suggestions sometime result in "partial" and sometimes "complete" false recollection (Hyman, Husband, & Billings, 1995), a concept revisited in a recent mega-analysis of false-memory implantation studies (Scoboria et al., 2016). Whereas it has been valuable to study the conditions under which suggestions lead people to develop false autobiographical beliefs of varying strength, it is also valuable to consider the conditions under which disconfirming feedback affects autobiographical beliefs, to greater or lesser extents.

Are nonbelieved memories a unitary phenomenon?

Because people's ratings of belief in occurrence and recollection vary substantially for NBMs, it seems possible that naturally-occurring NBMs are not a unitary phenomenon. In this paper we explore whether NBM reports are best grouped together into one single category, or whether they are better explained using multiple categories. Examining distinct clusters of NBMs has the potential to shed light on differential factors that influence people's decision-making about vivid memories, and to point to distinct underlying processes. For example, assuming that distinct clusters can be reliably identified, what variables might discriminate between these clusters? In two studies, we asked whether any clusters, defined based on patterns of belief and recollection judgments, might be distinguishable in terms of recollective characteristics (e.g., visual, spatial), narrative coherence, event importance, event plausibility, and connectedness. Furthermore, we asked whether the different social or cognitive processes that lead to the full or partial withdrawal of belief might distinguish clusters of NBMs.

The literature points to distinct types of NBMs that might be found. The first is the kind originally described by Mazzoni et al. (2010) and discussed above, which is characterized by high recollection ratings accompanied by low ratings of belief in occurrence. Such memories would reflect a relinquishment of belief, and so we should expect them to be distinguished by strong recollective characteristics, perhaps combined with a report of discovering compelling disconfirming evidence. A second NBM-type should reflect the partial reduction of belief, with high recollection ratings but only slightly lower ratings of belief in occurrence. These NBMs might be particularly likely in instances where the disconfirming evidence is weaker and does not substantially outweigh the strength of episodic recollection, yet nevertheless creates a degree of doubt. A third type of NBM might involve low ratings of belief in occurrence, and ratings of recollection that are also low albeit higher than belief in occurrence. Such NBMs could occur

when a recollection is naturally weak and so appraised as unreliable, and/or when encountering disconfirming evidence about a relatively strong memory has undermined both belief in occurrence *and* recollection. It is not possible to distinguish these two types of memories based on retrospective reports alone (i.e., to know whether a weak memory is not believed simply because it is weak, or whether it has become weaker after exposure to disconfirming feedback); nevertheless either of these forms of memory might emerge as a distinct cluster among participants' reports. In the two studies reported here, we explored the variability among reports of naturally-occurring NBMs, using cluster analytic techniques to address whether any of these predicted clusters might be empirically distinguishable.

Study 1

Method

In Study 1, we combined data from Scoboria et al.'s (2014, Study 2, $N = 182$), and Scoboria, Memon, Gawrylowicz, and Clark's (2015, $N = 138$) surveys of naturally-occurring NBMs. The first dataset sampled Canadian university students using an online survey. The second dataset sampled Mechanical Turk workers, again using an online survey. The demographic characteristics of the combined sample used here ($N = 320$) were: 61.5% female, 37.2% male, 1.2% of non-binary gender; $M_{age} = 31.48$, $SD = 8.14$, range = 17-72.

Aside from differences in how the two samples were recruited, the online survey was identical for both samples. Individuals were first provided with a definition of NBMs, and asked whether they had such a memory. Those who indicated that they did were invited to complete the survey. Participants described the event in their memory, and dated when it ostensibly occurred. They also described when and why they altered their belief in the memory, dated when this change in belief occurred, and they rated the NBM on (1) belief in occurrence, (2) recollection,

and (3) additional memory characteristics. After providing these data about their NBM, they also described and rated a believed memory, and a believed-not-remembered event that were from approximately the same age as the event in the NBM.

Measures

Belief in occurrence. The three scale-items from Scoboria et al. (2014) were used to measure belief in the occurrence of events. These items used 7-point scales to assess judgments of the likelihood of event occurrence, strength of belief that the event occurred, and the truth of whether the event occurred.

Recollection. The three scale-items from Scoboria et al. (2014) were used to measure recollection. The items used 7-point scales to assess judgments of memory for the event, strength of memory, and remembering rather than knowing the details of the event.

Memory characteristics. Additional self-report items served as indicators of the phenomenological qualities of recollection. These items are variants of those described by Johnson, Foley, Suengas, and Raye (1988), Rubin, Schrauf, and Greenberg (2001), and D'Argembeau and Van der Linden (2004). Single items assessed visual detail, personal importance, narrative coherence, connectedness of the event to other events in memory, and the personal plausibility of events. Three items assessed spatial characteristics associated with the event (location, object, setting), and two items assessed re-experiencing (reliving, mental time travel); the items for spatial characteristics and those for re-experiencing were separately averaged to create two scale scores. The spatial characteristics and re-experiencing scales both demonstrated high internal consistency, with scale alphas at or above .74. Participants rated all items using 7-point scales except for plausibility, which they rated using an 8-point scale.

Reasons for altering belief. All NBMs were coded using the system described by Scoboria, Boucher, and Mazzoni (2015), which differentiates the reasons participants give for altering belief in their memory. The coding system comprises eight primary categories of reasons (social feedback, event plausibility, alternative attributions, general beliefs about memory, internal evidence, external evidence, alternate attributions, views of self/others, personal motivation). Most categories have additional sub-categories, and each individual NBM may be coded into more than one of these categories or sub-categories. The most complex category is social feedback, which contains three sub-categories (direct social contradiction, lack of corroboration, socially motivated invalidation). A brief description of each major category and sub-category from their paper is provided in Table 1. To code the narratives, two raters were trained and practiced rating unrelated transcripts. The raters then applied the coding system to the total body of reports, resulting in good agreement (kappas ranging from .82 to .99 by category). Disagreements were resolved via discussion.

Results

Cluster analysis. Cluster analysis is primarily an exploratory data mining procedure (but see Study 2 for our approach to confirming the cluster solution identified in Study 1). Briefly, cluster analysis works by seeking to group together cases that are similar, while simultaneously identifying differences between distinct groups of cases. This is accomplished by calculating estimates of within- and between-group linkages, which can be accomplished in a variety of manners depending on the type of algorithm that is applied.

We used a combination of hierarchical and K-means approaches to clustering the data, using SPSS v23. We entered the six key items (3 indexing belief in occurrence, 3 indexing recollection) to explore cluster solutions. We began with hierarchical analysis, which emphasizes

the connectivity between cases and distance between potential clusters, and permits exploring how many clusters might reasonably be present in the data. We used the Squared Euclidian measure and both the between-groups linkage and Ward methods to extract clusters. Examination of the resulting dendograms (a graphical depiction of the maximum distances needed to connect cases into clusters) suggested that between three and eight clusters were potentially present. We then conducted a series of K-means cluster analyses, in which the algorithm seeks to assign all cases to a number of specified clusters. We produced solutions ranging from three to eight clusters. We examined between-cluster and within-cluster distance measures, and chose the three cluster solution as the most parsimonious solution that produced distinct groups. A second component of the analytic plan was to seek to confirm the cluster solution in an independent dataset; this step is reported in Study 2 below.

The number of cases assigned to each cluster ranged from 106 to 117, indicating that each cluster was well represented in the dataset. Average belief in occurrence and recollection ratings by cluster are provided in Figure 1. Per the 95% CIs depicted on the figure, all three clusters were characterized by belief in occurrence ratings that were statistically lower on average than recollection ratings. Thus the data upheld the general notion that belief in occurrence is reduced to some extent relative to recollection. Newly observed here is that the difference between belief in occurrence and recollection varies across NBM sub-types.

Cluster 1 was characterized by moderate recollection ratings that fell on average slightly below the scale mid-point, and by belief in occurrence ratings that were meaningfully lower than the recollection ratings (M_{diff} = 0.89, 95% CI_{diff} = [0.66, 1.12]; d = 0.79). Interpretation of this cluster is complicated by the observation made previously, namely that it is impossible to determine retrospectively whether these memories were weak prior to the development of the

NBM, became weaker after the belief in occurrence was undermined, or both. Therefore we must consider both possibilities when interpreting this cluster, which we labeled "Weak NBMs".

Cluster 2 matched prior descriptions of NBMs in the literature, as characterized by strong recollection associated with substantially lower autobiographical belief. Here, recollection ratings were close on average to the scale ceiling, and autobiographical belief ratings fell well below the scale mid-point. The average mean difference between belief in occurrence and recollection was 3.49 (95% CI_{diff} = [3.26, 3.71]; d = 3.04). We labeled the cases in Cluster 2 as "Classic NBMs".

The recollection ratings for Cluster 3 were similar to those made for Classic NBMs. However, belief in occurrence ratings were substantially higher in Cluster 3, albeit these ratings still remained statistically lower than the recollection ratings (M_{diff} = 0.39, 95% CI_{diff} = [0.18, 0.61]; d = 0.36). This cluster appeared to represent cases in which belief in the event has been brought into question, but not substantially undermined. Given that for believed memories, belief in occurrence ratings typically exceed recollection ratings (and indeed this was true in this study), this cluster supports the assertion that the choice to rate belief lower than recollection to any degree is meaningful. We labeled the cases in Cluster 3 as "Grain of Doubt NBMs".

Predicting the clusters. We next explored whether any of the additional variables might help to differentiate and describe the three clusters. Due to differences in item scaling, we examined the (continuous) self-report ratings of memory characteristics, and the (dichotomous, absent/present) coded reasons for withdrawing belief separately.

Memory characteristics. Average ratings by cluster for the eight continuous memory characteristic items are provided in Figure 2 (visual detail, spatial detail, re-experiencing, rehearsal, coherence, connectedness, significance, plausibility). Differences between clusters for

each item can be ascertained by examining the confidence intervals. We also conducted a discriminant function analysis with these eight variables to determine which, if any, reliably distinguished the three groups. Both of the resulting functions differentiated the groups; Function 1, Wilks' Lambda = .57, χ^2 (16) = 182.24, $p < .001$; Function 2, Wilks' Lambda = .83, χ^2 (7) = 62.98, $p < .001$. The resulting structure matrix and group centroids are provided in Table 2. The first function discriminated Grain of Doubt NBMs (Cluster 3) from Weak and Classic NBMs (Clusters 1 and 2, respectively); Grain of Doubt NBMs were characterized by higher plausibility ratings compared with the other two clusters. Function 2 discriminated Weak NBMs from the other two clusters; Weak NBMs were characterized by lower visual, spatial, re-experiencing, and rehearsal ratings. Ratings of coherence, significance, and connectedness did not differentiate the clusters.

Reasons for withdrawing belief. We entered each of the categories as dichotomous (absent/present) covariates in a multinomial regression to predict differences between clusters; endorsement rates by cluster are reported in Table 3. Four items differentiated the clusters: references to subjective plausibility, references to being told that the event did not occur, references to inability to obtain corroboration, and references to the memory being inconsistent with images of other people. Specifically, participants with Grain of Doubt NBMs less frequently mentioned subjective plausibility (Cluster 3; 20.5%) than did those in the other two clusters (37.0%) (C1 v. C3, Wald = 10.48, Exp(B) = 2.74 [1.49, 5.06], $p < .001$; C2 v. C3, Wald = 12.05, Exp(B) = 3.07 [1.63, 5.79], $p = .018$). Being told by another person that the event did not occur was also mentioned less frequently by those individuals with Grain of Doubt NBMs (15.3%) than in the other two clusters (24.7%), (C1 v. C3, Wald = 10.48, Exp(B) = 2.74 [1.49, 5.06], $p < .001$; C2 v. C3, Wald = 12.05, Exp(B) = 3.07 [1.63, 5.79], $p = .018$). References to

inability to obtain social corroboration was mentioned more frequently by those with Classic NBMs (21%) than by those with Grain of doubt NBMs (7%), (Wald = 6.05, Exp(B) = 2.92 [1.24, 6.85], p = .014). Finally, references to information not being consistent with images of others were made more often by those with Weak NBMs (13%) than in the other clusters (4%), (C1 v. C2, Wald = 4.73, Exp(B) = 3.55 [1.13, 11.14], p = .030; C1 v. C3, Wald = 5.65, Exp(B) = 2.92 [1.24, 6.85], p = .014).

Together, the results of Study 1 show that while nonbelieved memories are characterized by recollection ratings that exceed belief in occurrence ratings, three distinct sub-types of NBMs may exist. These sub-types differ systematically, not only in terms of the strength of recollection and of belief in occurrence, but also in terms of their recollective qualities, and in terms of the factors that influenced the full or partial withdrawal of belief. Although identifying these sub-types therefore gives us new evidence that NBMs are not a unitary phenomenon, our data also support the occurrence of NBMs even as they were originally defined.

Study 2

The results of Study 1 show that while nonbelieved memories are characterized by recollection ratings that exceed belief in occurrence ratings, three distinct types of NBMs emerge. However, the data reviewed to this point might conceal a more complex picture in terms of varieties of NBM. In their review of reasons for withdrawing belief in vivid memories, Scoboria, Boucher, and Mazzoni (2015) documented that some individuals describe altering belief because somebody told them that the event never occurred, whereas others alter belief because somebody told them that their memory for certain details was incorrect. The first kind of feedback would seem to primarily target belief in occurrence (i.e., the truth status of the entire event) and would likely be well represented by the clusters identified in Study 1. The second

kind of feedback, however, would target a different metacognitive judgment not explored in Study 1: belief in the accuracy of recollected information.

Incorporating belief in accuracy

Much of the discussion in the literature on NBMs has focussed on the distinction between belief in occurrence and episodic recollection. However, belief in occurrence is not the only appraisal of veridicality present for autobiographical event representations. Rubin (2006) has theorized that appraisals of memory accuracy arise out of cognitive processes that are distinct from those that produce recollection. A body of research demonstrates that appraisals of recollection and appraisals of the accuracy of recollection are empirically distinct (Rubin et al., 2003; Fitzgerald & Broadbridge, 2012), and indeed that both appraisals are empirically distinct from appraisals of belief in occurrence (Scoboria, Talarico, & Pascal, 2015; Scoboria & Pascal, in press).

Given these developments, it is important that ideas about belief in the accuracy of events are incorporated into thinking about NBMs. To date, the discussion of belief in accuracy has been scant in the context of NBMs. Scoboria and Pascal (in press) reported that ratings of belief in accuracy for naturally-occurring NBMs averaged around the mid-point of the rating scale, similarly to belief in occurrence ratings. In other words, just like belief in occurrence, belief in accuracy ratings are not reduced to the scale floor, and vary across participants. Thus the same arguments made above about variability in belief in occurrence ratings can be applied when incorporating belief in accuracy into discussion of NBMs.

In short, people with NBMs may be reporting changes to belief in occurrence and/or changes to belief in accuracy. It is therefore interesting to examine what recollective characteristics, and what types of disconfirming information, are associated with

change/withdrawal of belief in occurrence, belief in accuracy, or both. In Study 2, we examined a dataset of NBMs similar to those used in Study 1, except that each memory was rated on belief in accuracy, as well as on recollection and belief in occurrence. We predicted that each cluster of NBMs from Study 1 would split into two or more sub-clusters, distinguished in terms of high vs. low belief in accuracy. In particular we expected that this would be true for the "classic" NBMs from Study 1, for in which recollection ratings were high but belief in occurrence ratings were low. Whereas we would typically expect these Classic NBMs to be accompanied by low belief in accuracy; however, a cluster of Classic NBMs in which belief in accuracy remains high might also exist, encompassing cases for example of "borrowed memories" (see Brown et al., 2015). In these cases a person recalls an event and is able to corroborate the details, and yet also discovers that they had not truly been present, and instead had learned the details from another person. In a similar manner, we predicted that Cluster 3 from Study 1 – in which both recollection and belief in occurrence were rated high – would split into two further clusters, one of which would involve low ratings of belief in accuracy, and the other would involve high ratings of belief in accuracy. In the present study, we again asked whether any such clusters of NBMs might be discriminable based on recollective characteristics, or the reasons for changing/withdrawing belief.

Method

In Study 2 we analyzed the data from Scoboria and Pascal (in press, Study 1), which were collected online using Mechanical Turk. The sample used here included all individuals from that dataset who provided a useable NBM (N = 308). Demographic information was provided by 296 individuals: 49% female, 50% male, 1% of non-binary gender; M_{age} = 35.28, SD = 12.24, Range = 18-82; self-identified race/ethnicity: 3.4% Asian, 5.7% black, 13.0% mixed, 6.1% Hispanic origin, 81.2% white. Almost all (99.3%) reported living in the United States.

The procedure used to obtain the data was identical to Study 1, with one difference. After describing and dating the NBM, participants were also asked to describe how the loss of the memory affected them personally (this information is not discussed in the current paper). Participants then continued to rate the NBM.

Measures. The same items as in Study 1 were used to measure belief in occurrence, recollection, and recollective characteristics, with the addition of the belief in accuracy items described below. The same coding system was applied to categorize participants' reasons for withdrawing belief; kappas for all categories were reasonable (.79 to .98 by category).

***Belief in accuracy*.** The three highest loading items from Scoboria, Talarico, and Pascal (2015, Study 2) were used to assess belief in accuracy. Using 7-point scales, these items queried judgments of confidence that the memory is accurate, proportion of the memory that is accurate, and doubts about the accuracy of the memory.

Study 2 Results

Cluster analysis. We first sought to confirm the findings from Study 1 using this different dataset. We conducted a K-means cluster analysis using the same six items as in Study 1 (3 belief in occurrence, 3 recollection), assuming that three clusters would result. The pattern of belief in occurrence and recollection ratings for the three resulting groups closely resembled the pattern reported in Study 1 (see Figure 3). Cluster 1 was once again comprised of weaker overall reports, with belief in occurrence ratings that were lower than recollection ratings (M_{diff} = 0.28, 95% CI_{diff} = [0.03, 0.53], d = 0.29). Cluster 2 was characterized by strong recollection and weaker belief in occurrence (M_{diff} = 3.48, 95% CI_{diff} = [3.27, 3.69], d = 4.31). Cluster 3 included cases for which belief was higher, but remained statistically lower than recollection (M_{diff} = 0.50, 95% CI_{diff} = [0.23, 0.76]; d = 0.54).

Incorporating belief in accuracy. We then added the three belief in accuracy items to the clustering models to explore whether a sub-division of the three clusters and/or novel clusters would emerge. We approached clustering in two manners. First, we used three separate K-means cluster analyses to explore if each of the three clusters described previously were best described as being comprised of one or two clusters. We entered the nine key items (three belief in occurrence, three recollection, three belief in analyses) within each cluster separately. We found that Clusters 2 and 3 split into two clusters apiece that were differentiated notably by belief in accuracy ratings. The two clusters that resulted when examining Cluster 1 were substantially similar, and we therefore retained a single cluster.

In a second set of K-means analyses, we explored cluster solutions using the nine items that ranged between three and six clusters. The five cluster solution closely resembled the solution described in the preceding paragraph. Due to the convergence in solutions between the two clustering approaches, we selected five clusters as a reasonable description of the data in Study 2. Average belief in occurrence, recollection and belief in accuracy ratings for the resulting five clusters are provided in Figure 4. Average ratings for believed memories and believed-not-remembered events across participants in the sample are also provided in Figure 4 for the purposes of comparison.

Clusters 2.1 and 2.2 both resembled the Classic NBM Cluster from Study 1, in that recollection ratings were high and belief in occurrence ratings low. Belief in accuracy ratings differed between these clusters. In Cluster 2.1 belief in accuracy was rated at a low level similar to belief in occurrence. The pattern in this cluster indicated strong recollection with substantial reductions in both types of belief. In Cluster 2.2 belief in accuracy was rated at a high level

similar to recollection. The pattern for this cluster indicated reduced belief in occurrence in the presence of sustained recollection and belief in the accuracy of recollected details.

Clusters 3.1 and 3.2 both resembled the Grain of doubt NBM Cluster from Study 1, in that belief in occurrence ratings were relatively high, but remained statistically lower than recollection ratings. In Cluster 3.1, belief in accuracy ratings were high and similar to recollection ratings. In Cluster 3.2, belief in accuracy ratings were notably lower than both belief in occurrence and recollection.

Memory characteristics. Average ratings for the continuous memory characteristic items by cluster are provided in Figure 5. Ratings for believed memories and believed-not-remembered events are included, for the purpose of comparison. We conducted a discriminant function analysis with the eight continuous variables to determine which, if any, reliably distinguished the five clusters. The first two functions differentiated the groups; Function 1 Wilks' Lambda = .37, χ^2 (32) = 300.85, $p < .001$; Function 2 Wilks' Lambda = .60, χ^2 (21) = 151.44, $p < .001$. The third and fourth functions did not reach statistical significance, and are not reported further. The resulting structure matrix and group centroids are in Table 4. The first function reflected plausibility ratings, which were highest for Clusters 3.1 and 3.2, moderate for Cluster 1, and lowest for Clusters 2.1 and 2.2. Function 2 discriminated Cluster 1 from the other clusters; Cluster 1 was characterized by lower ratings of visual and spatial detail.

We next examined whether any of the items discriminated between the sub-divisions in Clusters 2 and 3. Clusters 2.1 and 2.2 showed similar ratings across the items, with the single exception of lower coherence ratings in C2.1. Cluster 3.1 showed higher visual, spatial, and re-experiencing ratings than Cluster 3.2. Also interesting, ratings for Cluster 3.1 were higher than believed memories for these same three items. Thus the cluster of NBMs that was associated

with strong recollection and belief in accuracy showed particularly strong recollective characteristics.

Reasons for withdrawing belief. Endorsement by cluster is provided in Table 5. To examine the replicability of the findings from Study 1, we first conducted multinomial regression analyses to predict the three cluster solution using the variables identified in Study 1 (subjective plausibility, told event did not occur, lack of corroboration). Subjective plausibility was statistically associated with cluster membership (C1 v. C2, Wald = 10.66, Exp(B) = 5.29 [1.95, 14.36], $p < .001$; C2 v. C3, Wald = 5.57, Exp(B) = 2.82 [1.19, 6.68], $p = .018$). In Cluster 2, 22.1% of participants made reference to subjective plausibility, as compared to 7.7% in the other groups. Inconsistency with images of others was also associated with cluster membership (C1 v. C2, Wald = .95, Exp(B) = 0.16 [0.63, 4.0], $p = .331$; C2 v. C3, Wald = 4.87, Exp(B) = 3.34 [1.16, 9.66], $p = .026$). In Cluster 2, 14% of participants made reference to inconsistency with images of others, as compared to 5% in Cluster 3.

Examination of the five cluster solution revealed that the finding for subjective plausibility extended to the sub-classification (Cluster 2.1, 25%; Cluster 2.2, 22%). Those in Cluster 2 consistently made more references to the subjective plausibility of the event across the studies as a basis for deciding to alter belief in the memory. However, whereas in Study 1 subjective plausibility was mentioned in Cluster 2 approximately as often as in Cluster 1, here in Study 2 the proportion in Cluster 2 was also significantly greater than in Cluster 3. Individuals in Cluster 2.1 (but not Cluster 2.2) made more references to inconsistency with images of others compared to both of the Cluster 3 groups (17% vs. 5%).

We then explored whether any of the reason for altering belief discriminated between the sub-divisions in Clusters 2 and 3. Two items did discriminate between Cluster 2.1 and Cluster

2.2 (the Classic NBMs): Told impossible (Wald = 6.92, Exp(B) = 9.60 [1.78, 51.75], p =. 009; C2.1: 7.4%, C2.2: 25.0%); and Objective plausibility (Wald = 4.90, Exp(B) = 6.58 [1.24, 34.88], p = .027; C2.1: 18.8% vs. C2.2: 3.7%). Objective plausibility was the only variable that discriminated between Cluster 3.1 and Cluster 3.2 (Grain of doubt NBMs), (Wald = 6.81, Exp(B) = 31.56 [2.36, 422.09]; C3.1: 22.7% vs. C3.2: 3.4%).

General Discussion

These studies revealed that there are a number of distinct outcomes that result when memories are brought into question and become NBMs. In Study 1 we discovered three distinct types of NBMs. In Study 2 these same kinds of NBM emerged once again, and two of the three were further sub-divided in terms of belief in the accuracy of the recalled details. Each of the different kinds of NBM had interesting hallmarks, which we discuss shortly, but it is important to also note that they all shared some commonalities. First, all types were characterized by belief in occurrence that is weaker than recollection (Scoboria et al., 2014). Second, as per the findings from many prior studies, all types were richer than believed-not-remembered events in terms of several subjective characteristics such as visual and spatial details, and the sense of re-experiencing the past (e.g., Mazzoni et al., 2010). Third, all types were most commonly accompanied by verbal descriptions of having been challenged by some kind of social source (Scoboria, Boucher, and Mazzoni, 2015). Together these studies show us that many of the characteristics thus far believed to be defining features of NBMs are indeed robust, even despite there being wide variation between NBMs and their causes.

Despite these common features, across our datasets the difference between ratings of belief in occurrence and of recollection for NBMs ranged considerably, from large to fairly small. When the differences were large (i.e., the ‘Classic NBMs’, compatible with a clear

"withdrawal" of autobiographical belief), these NBMs were comparable in most respects to believed memories, and had typically been challenged by some form of social influence. However, the Classic NBMs were also more likely than other NBM-types to have been challenged in terms of their plausibility. The evidence of these queries over plausibility was indexed both in participants' memory characteristic ratings, and in their verbal descriptions of the reasons that led them to question the memory. Plausibility challenges therefore seem to be associated with the formation of Classic NBMs more often than the other kinds, in which belief in occurrence is undermined to a lesser extent.

Another kind of NBM was characterized by strong recollection, but only slightly weakened belief in occurrence. These 'Grain of doubt' NBMs have previously received little attention in this literature, although their existence is unsurprising given that (a) the average NBM in Scoboria et al.'s (2014) work did not involve an entire withdrawal of belief in occurrence, and (b) memories are sometimes defended rather than abandoned, even in spite of contrary evidence. It is interesting that belief in occurrence ratings were reliably lower than recollection ratings for such Grain of doubt NBMs even though the difference was small. For believed memories, belief in occurrence ratings typically equal or exceed recollection ratings; the current studies therefore reinforce the notion that people's choice to rate belief in occurrence lower than recollection to any degree (even one point lower) indicates that decision making processes related to the truth status of the event have occurred (see Scoboria & Talarico, 2013).

The Weak NBMs, unsurprisingly, were weaker than believed memories across the range of subjective characteristics, albeit also stronger than believed-not-remembered events in most respects. These memories are more complex than the other kinds to interpret, as we have already noted. These cases may reflect memories that were weak even prior to becoming NBMs, or they

may reflect cases in which both belief in occurrence and recollection have been undermined. In this instance, future work is needed to differentiate instances in which recollection is retained versus undermined in response to evidence about the event. Such work would inevitably require memories to be probed and tracked across multiple time-points, to track the dynamic shifts in metamemory appraisals before and after challenges.

This paper also advances understanding of the relationship of belief in accuracy judgments to NBMs. The results indicate that both Classic NBMs and Grain of doubt NBMs can be sub-divided based on relatively high or low belief in accuracy ratings. Within the Classic NBMs, cases that were characterized by lower belief in accuracy were judged by participants to be less coherent than were those characterized by higher belief in accuracy. They were also more commonly accompanied by reports of having been told that the event was impossible. For the Grain of doubt NBMs, the cluster characterized by lower belief in accuracy was associated with lower visual, spatial, and re-experiencing ratings, as compared with the cluster characterized by higher belief in accuracy, and the verbal reports for the former cluster more often contained verbal reports concerning objective implausibility.

While it is somewhat expected that belief in accuracy is linked with the recollective qualities of the remembered event, these data also suggest that the objective plausibility of events and social influence interact with other characteristics in determining the level of belief in accuracy for NBMs. It is interesting to notice also that the Weak NBM cluster did not split into two clusters when belief in accuracy was added to the analyses. This variable was rated at the same level as belief in occurrence and recollection, indicating that these memories are probably of relatively poor quality overall. One possibility to explore in future studies is whether the

relatively low recollective quality might a determinant of the low belief in occurrence and accuracy.

This paper, which examines exclusively spontaneous NBMs, supports the conclusion that future work is needed to examine the factors and underlying processes that result in the different types of NBMs observed here. In particular, little information has been obtained in the present studies on the specific reasons to revise belief in occurrence in the case of 'Grain of Doubt' or 'Weak' NBMs. Studies that measure the characteristics of vivid memories prior to the development of NBMs would permit exploration of how baseline characteristics relate to changes in the various ratings of interest. Such studies are difficult to conduct under naturalistic circumstances, and thus will likely need to be performed in the laboratory. We also reiterate that NBMs are just one outcome that may result when the occurrence and/or accuracy of vivid memories are brought into question by other evidence, as other outcomes remain possible (e.g. defending the memory).

The current results provide important elements for the prediction of the outcome of future studies examining clusters of experimentally created NBMs (such as in Clark et al, 2012; Mazzoni et al, 2014; Otgaar et al, 2014). For example, one could expect that 'Classic NBMs' are more likely in cases in which the plausibility of the event is challenged by others, whereas manipulations that question the recollective qualities of the memories could be more likely to result in 'Weak NBMs' (this could be also a way to assess whether 'Weak NBMs' result from strongly undermined memories, or from undermined memories that were already initially relatively vague and of poor quality), and procedures undermining objective plausibility should produce 'Grain of doubt NBMs' with low beliefs in accuracy. These results would also make it possible to predict that the personal realization that the event is indeed impossible (objective

implausibility) would produce ‘Classic NBMs’ characterized still by high ratings in memory accuracy, whereas social feedback (e.g. telling people that the event was impossible) would lead to ‘Classic NBMs’ that have also low ratings in memory accuracy. Distinguishing these sub-types of NBMs may also be useful when developing research to identify individual difference factors that predict nonbelieved memories.

Conclusions

Nonbelieved memories (NBMs) can be conceived as a unitary counterintuitive phenomenon in which a person claims to have a vivid episodic recollection of an event, despite some reduction in belief that the recollection is veridical. However, the evidence presented here demonstrates that NBMs are also diverse in the extent to which belief in occurrence is relinquished. Different reasons determine different degrees of belief withdrawal, with event plausibility and social feedback about the existence and possibility of the event being the strongest reason to stop believing in a memory that is still vivid.

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Table 1. Reasons for altering belief in vivid memories

Category	Description
Social	
Told did not occur	Feedback that the event did not occur, and/or others deny event.
Told happened differently	Feedback that details within the event happened differently.
Told impossible	Feedback that event could not have occurred.
Told unlikely	Feedback that the event could have occurred but it is unlikely.
Told happened to someone else	Feedback that the event (or event features) happened to someone else.
Non-verbal feedback	Intentional non-verbal feedback (e.g., look of disbelief, laughing, etc).
Told was not there	Feedback that was not present to witness event.
Lack of corroboration	Feedback provided that the memory cannot be confirmed.
Feedback not sought/provided	Does not seek feedback and others do not provide it.
Others unavailable	Does not receive feedback because key other(s) unavailable.
Pressured by others	Feedback appears motivated (memory poses consequences for other).
Refusal to discuss	Seeks feedback but other(s) refuse to provide (other may be motivated to avoid).
Plausibility	
Subjective	States event is impossible/implausible based on feelings, tastes, or opinions.
Objective	Event judged impossible/implausible for commonly accepted axioms of reality.
Alternate attributions	
Internal, Asleep	Memory may have resulted from a dream or nightmare.
Internal, Awake	Memory may have resulted from fantasy, imagination, etc.
Other mental state	Memory may have resulted from another cause (hallucination, substance, etc.).
External	Memory may have resulted from an external source (movie, T.V., book, etc.).
General metamemorial beliefs	
Memory and age	Belief memories cannot occur when very young or unreliable from childhood.
Memory integrity	Belief in memory ability, that c/b false; result from expectations, etc.
Memory influence	Belief that true memories should have an enduring influence.
Internal	
Atypical internal characteristics	Something unusual about memory (features disorganized, feels unreal, etc.).
External evidence (non-social)	
Disconfirming evidence obtained	Seeks or confronted with evidence that threatens the validity of the memory.
Confirming evidence not obtained	External evidence that validates the memory is absent or cannot be obtained.
Notions of self/others	
(In)consistency w/self-image	States event (or features) is at odds with whom they regard themselves to be.
(In)consistency w/image of other(s)	Sates event (or features) is at odds with the image they hold of other(s).
Motivation	
Motivation to relinquish belief	Motivated to stop believing confirmatory, or believe disconfirmatory evidence.

Note: Complete details about the coding system are reported in Scoboria, Boucher, & Mazzoni (2015).

Table 2. Study 1, Discriminant function analysis Structure matrix and Functions at Group Centroids

	Function	
Structure matrix	1	2
Visual	.41	.61
Spatial	.25	.64
Reexperiencing	.34	.47
Rehearsal	.26	.51
Coherence	.36	.36
Connected	.19	.12
Significance	.36	.04
Personal plausibility	.78	-.54
Function at group centroids	1	2
Cluster 1 (Weak)	-.16	.67
Cluster 2 (Classic)	-.72	-.40
Cluster 3 (Grain of doubt)	.84	-.21

Note: Unstandardized canonical discriminant functions evaluated at group means

Table 3. Study 1, References to reasons for altering belief, by cluster.

		Cluster 1 Weak NBM (n 113)	Cluster 2 Classic NBM (n 106)	Cluster 3 Grain of doubt NBM (n 117)
Social	Told did not occur	.23 [.15,.31]	.26 [.18,.35]	.15 [.09,.22]
	Told happened differently	.07 [.03,.12]	.12 [.07,.19]	.11 [.06,.17]
	Told impossible	.06 [.03,.11]	.12 [.07,.20]	.12 [.06,.18]
	Told unlikely	.02 [.00,.04]	.05 [.01,.09]	.03 [.00,.06]
	Told happened to someone else	.03 [.00,.06]	.04 [.01,.08]	.03 [.00,.06]
	Non-verbal feedback	.01 [.00,.03]	.00 [.00,.00]	.01 [.00,.03]
	Told was not there	.00 [.00,.00]	.02 [.00,.05]	.03 [.00,.06]
	Lack of corroboration	.10 [.04,.15]	.21 [.12,.33]	.07 [.03,.12]
	Feedback not sought/provided	.01 [.00,.02]	.00 [.00,.00]	.01 [.00,.03]
	Others unavailable	.01 [.00,.03]	.00 [.00,.00]	.00 [.00,.00]
	Pressured by others	.01 [.00,.04]	.01 [.00,.03]	.05 [.02,.09]
	Refusal to discuss	.01 [.00,.03]	.02 [.00,.05]	.03 [.00,.06]
Plausibility	Subjective	.37 [.28,.47]	.37 [.28,.46]	.21 [.14,.28]
	Objective	.09 [.04,.14]	.18 [.10,.26]	.15 [.09,.21]
Alternate	Internal, Asleep	.12 [.06,.18]	.08 [.04,.14]	.09 [.03,.14]
	Internal, Awake	.21 [.13,.30]	.19 [.12,.27]	.15 [.09,.22]
	Other mental state	.03 [.00,.06]	.03 [.00,.07]	.02 [.00,.04]
	External	.02 [.00,.04]	.03 [.00,.07]	.03 [.01,.07]
General belief	Memory and age	.07 [.03,.12]	.08 [.04,.14]	.15 [.09,.22]
	Memory integrity	.03 [.00,.06]	.00 [.00,.00]	.00 [.00,.00]
	Memory influence	.14 [.08,.20]	.10 [.05,.14]	.11 [.06,.17]
Internal		.16 [.10,.23]	.14 [.08,.21]	.12 [.07,.18]
External	Disconfirming evidence obtained	.08 [.03,.13]	.08 [.03,.13]	.10 [.05,.16]
	Confirming evidence not obtained	.04 [.01,.08]	.08 [.04,.14]	.07 [.03,.11]
Notions self/other	(In)consistency w/self-image	.02 [.00,.04]	.04 [.01,.08]	.02 [.00,.04]
	(In)consistency w/image of other(s)	.13 [.07,.20]	.04 [.01,.08]	.04 [.01,.09]
Motivation		.07 [.03,.12]	.02 [.00,.05]	.07 [.03,.12]

Table 4. Study 2, Discriminant function analysis Structure matrix and Functions at Group Centroids

	Function	
Structure matrix	1	2
Visual	.30	.65
Spatial	.38	.62
Reexperiencing	.52	.32
Rehearsal	.20	.38
Coherence	.37	.44
Connected	.29	.29
Significance	.33	.02
Personal plausibility	.79	-.39
Function at group centroids	1	2
Cluster 1 (Weak)	-.57	-.98
Cluster 2 (Classic)	-.45	.71
Cluster 3 (Grain of doubt)	-.75	1.12

Note: Unstandardized canonical discriminant functions evaluated at group means

Table 5. Study 2, References to reasons for altering belief, by cluster.

		Cluster				
		Cluster 1 Weak NBM	Cluster 2.1 Classic NBM, low b.acc	Cluster 2.2 Classic NBM, high b.acc	Cluster 3.1 Grain of doubt NBM, high b.acc	Cluster 3.2 Grain of doubt NBM, low b.acc
Social	Told did not occur	.33 [.23,.42]	.42 [.32,.53]	.28 [.13,.44]	.43 [.30,.57]	.46 [.34,.59]
	Told happened differently	.12 [.07,.20]	.14 [.06,.21]	.03 [.00,.09]	.09 [.02,.18]	.24 [.14,.36]
	Told impossible	.05 [.01,.11]	.04 [.00,.09]	.19 [.06,.34]	.09 [.02,.18]	.07 [.02,.15]
	Told unlikely	.01 [.00,.03]	.04 [.00,.09]	.06 [.00,.16]	.00 [.00,.00]	.07 [.02,.14]
	Told happened to someone else	.01 [.00,.03]	.04 [.00,.09]	.00 [.00,.00]	.05 [.00,.11]	.03 [.00,.08]
	Non-verbal feedback	.00 [.00,.00]	.04 [.00,.09]	.00 [.00,.00]	.03 [.00,.08]	.02 [.00,.07]
	Told was not there	.04 [.01,.09]	.10 [.04,.16]	.03 [.00,.09]	.02 [.00,.07]	.02 [.00,.05]
	Lack of corroboration	.17 [.10,.25]	.15 [.07,.23]	.16 [.06,.28]	.07 [.00,.14]	.15 [.07,.25]
	Feedback not sought/provided	.00 [.00,.00]	.01 [.00,.04]	.00 [.00,.00]	.02 [.00,.07]	.02 [.00,.07]
	Others unavailable	.03 [.00,.08]	.01 [.00,.04]	.00 [.00,.00]	.00 [.00,.00]	.00 [.00,.00]
	Pressured by others	.05 [.01,.10]	.09 [.02,.16]	.00 [.00,.00]	.09 [.02,.18]	.15 [.07,.25]
	Refusal to discuss	.00 [.00,.00]	.00 [.00,.00]	.00 [.00,.00]	.03 [.00,.08]	.00 [.00,.00]
Plausibility	Subjective	.07 [.01,.12]	.21 [.12,.31]	.25 [.13,.41]	.09 [.02,.18]	.08 [.02,.15]
	Objective	.09 [.03,.14]	.07 [.02,.14]	.25 [.13,.41]	.23 [.11,.36]	.03 [.00,.08]
Alternate	Internal, Asleep	.09 [.03,.15]	.11 [.05,.19]	.13 [.03,.25]	.00 [.00,.00]	.17 [.08,.27]
	Internal, Awake	.13 [.07,.21]	.26 [.17,.36]	.28 [.13,.44]	.18 [.09,.32]	.17 [.08,.27]
	Other mental state	.07 [.02,.12]	.07 [.02,.14]	.13 [.03,.25]	.00 [.00,.00]	.02 [.00,.05]
General belief	Memory and age	.14 [.08,.22]	.19 [.10,.27]	.03 [.00,.09]	.09 [.02,.18]	.08 [.02,.15]
	Memory integrity	.17 [.11,.26]	.17 [.10,.24]	.09 [.00,.22]	.11 [.04,.20]	.17 [.08,.25]
	Memory influence	.00 [.00,.00]	.00 [.00,.00]	.00 [.00,.00]	.00 [.00,.00]	.00 [.00,.00]
Internal		.10 [.04,.16]	.07 [.02,.12]	.00 [.00,.00]	.02 [.00,.07]	.08 [.02,.17]
External	Disconfirm evidence obtained	.10 [.04,.16]	.07 [.02,.14]	.13 [.03,.25]	.11 [.02,.20]	.05 [.00,.10]
	Confirm evidence not obtained	.04 [.01,.09]	.05 [.01,.10]	.16 [.03,.28]	.05 [.00,.11]	.02 [.00,.05]
Notions self/other	(In)consistency w/self-image	.01 [.00,.03]	.02 [.00,.06]	.00 [.00,.00]	.00 [.00,.00]	.00 [.00,.00]
	(In)consistency w/image of other(s)	.09 [.03,.15]	.17 [.10,.27]	.06 [.00,.16]	.05 [.00,.11]	.05 [.00,.10]
Motivation		.02 [.00,.05]	.00 [.00,.00]	.03 [.00,.09]	.11 [.02,.23]	.07 [.02,.14]

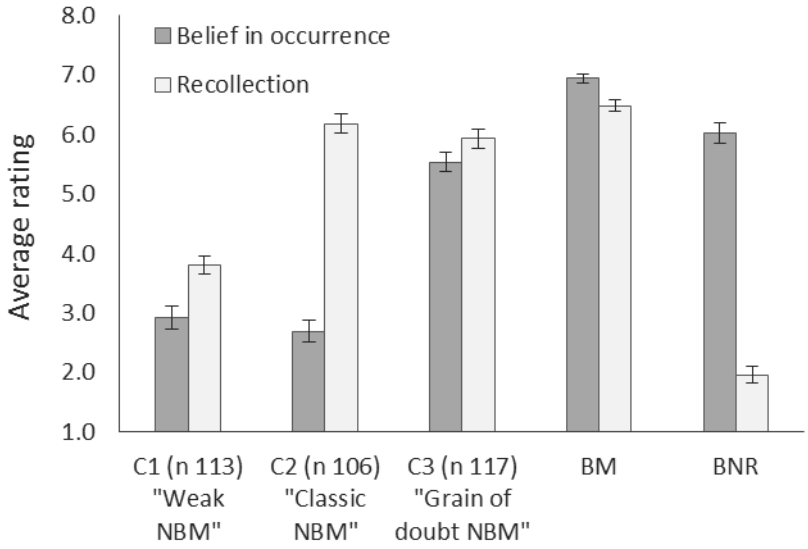


Figure 1. Study 1, Average belief in occurrence and recollection ratings for the three cluster solution. The numbers in parentheses are the Ns associated with each cluster. The error bars show 95% CIs. Belief in occurrence is statistically lower than recollection in all clusters. Average ratings for believed memories (BM) and believed-not-remembered events (BNR) are provided for the purpose of comparison.

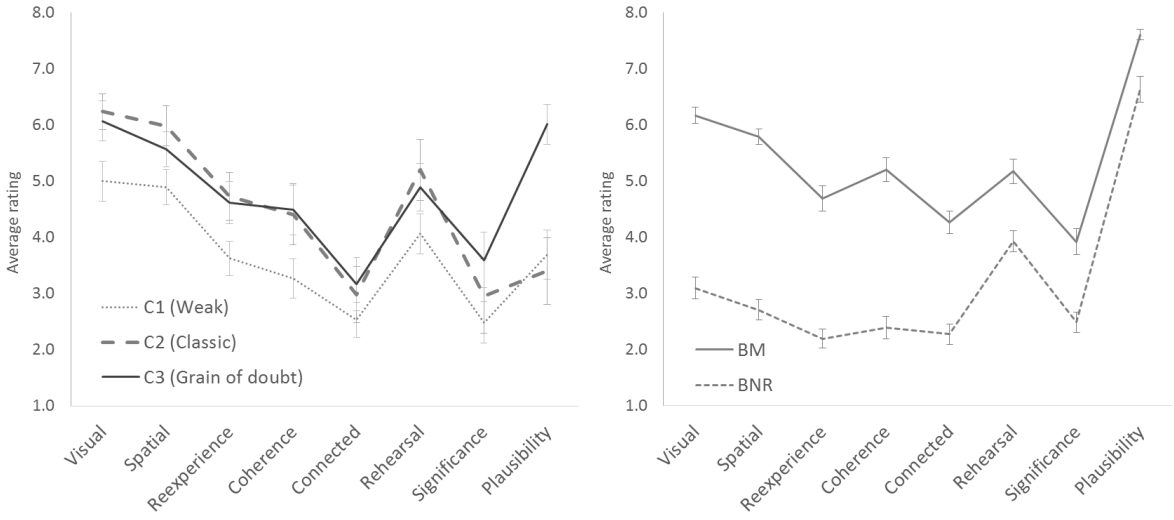
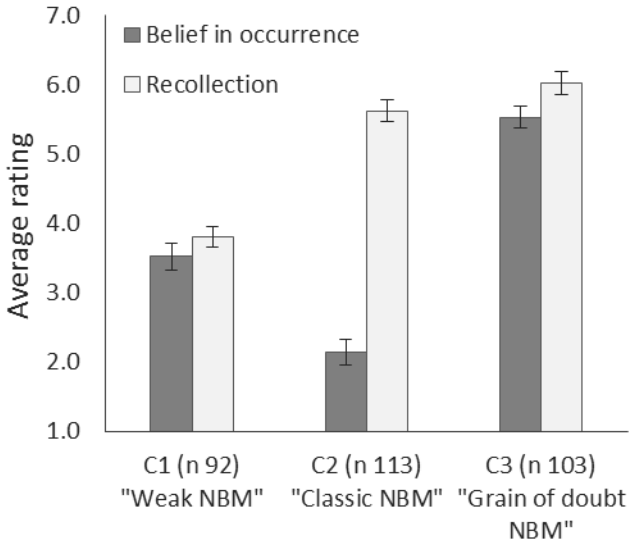


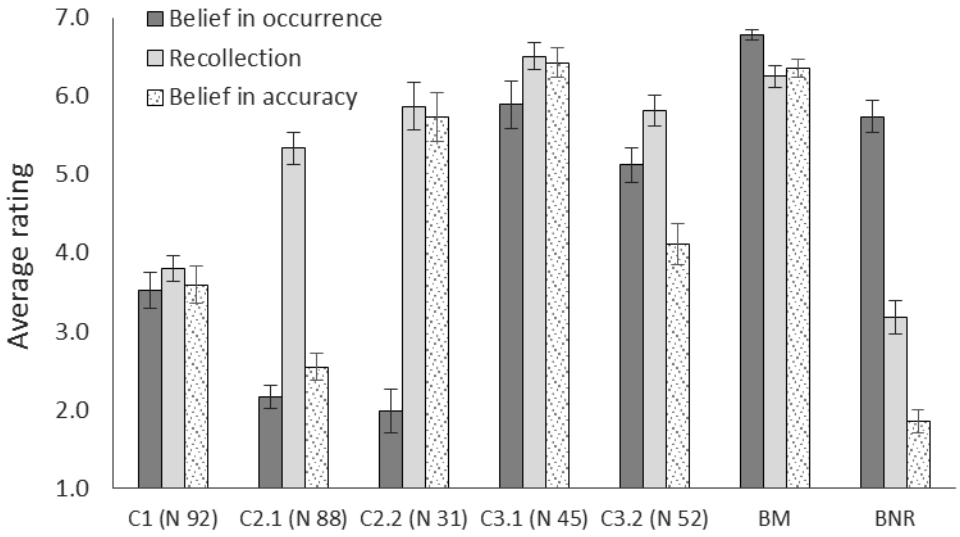
Figure 2. Self-report ratings by Cluster. Error bars show 95% confidence intervals. The figure on the right shows believed memories (BM) and believed-not-remembered events (BNR) for purposes of comparison.

Figure 3. Study 2, Cluster analysis using belief in occurrence and recollection items.

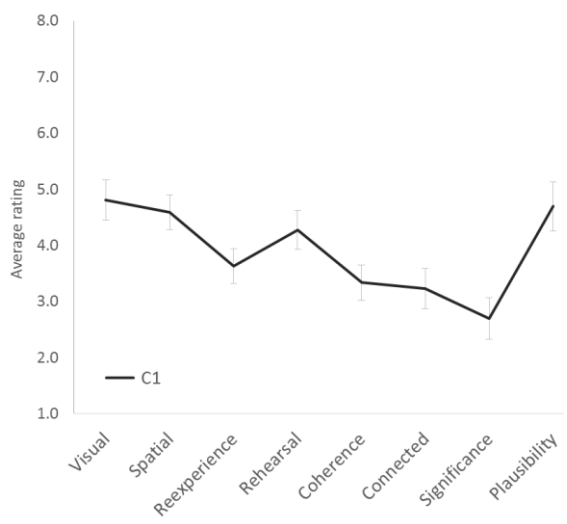


Note: Error bars show 95% CIs.

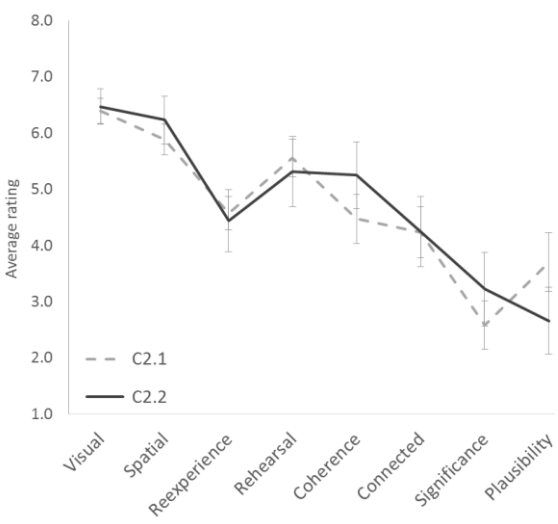
Figure 4. Study 2, Five cluster solution including belief in occurrence, recollection, and belief in accuracy.



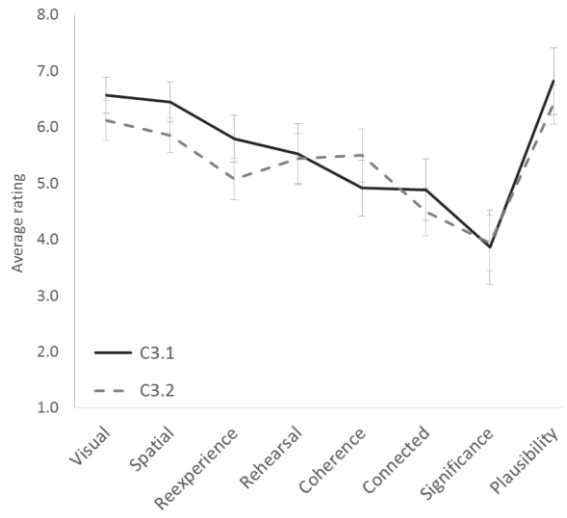
Note: BM – Believed memory; BNR – Believed not remembered event. C1 – Weak NBMs; C2 – Classic NBMs; C3 – Grain of doubt NBMs.



Cluster 1. "Weak NBMs"



Cluster 2. "Classic NBMs". C2.1 is characterized by lower belief in accuracy ratings.



Cluster 3. "Grain of doubt" NBMs. C3.2 is characterized by lower belief in accuracy ratings.

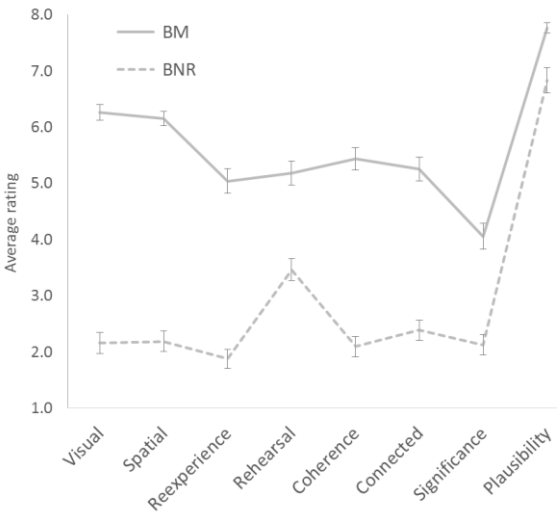


Figure 5. Study 2, Memory characteristic ratings for the five NBM clusters, believed memories (BM) and believed-not-remembered events (BNR). To facilitate clarity, the data are spread across multiple panels. Error bars show 95% CIs on the group means. The five clusters reflect distinct sub-groups; the ratings for believed memories (BM) and believed-not-remembered events (BNR) are taken across the entire sample.