Focused attention on one contextual attribute does not reduce source memory for a different attribute

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In three experiments, participants were asked to learn a particular contextual dimension of a study episode for a later memory test. The hypothesis being evaluated was that focused attention towards learning a particular source-specifying attribute would decrease memory for a different attribute dimension. Although source memory for the attribute dimensions in the focus of attention were generally improved, memory was not diminished for contextual attributes ostensibly outside the focus of primary attention. The absence of any decrease in memory appears to be a somewhat general phenomenon because it was found with external–external, internal–external, and internal–internal combinations of attribute dimensions. The results may be most consistent with a model of cognitive processing in which people have separate pools of attentional resources rather than a single pool of general resources.

In most standard investigations of source memory, material is presented from two origins that differ in contextual details such as their modality, medium, person, location, or occurrence in time (e.g., Johnson, Hashtroudi, & Lindsay, 1993). At test, participants are asked to discriminate between these two different types of old items, usually as well as to detect them from new items. Thus, the majority of source-monitoring tests require a three-alternative, forced-choice judgement. Broadly speaking, source decisions are made by inspecting the qualitative characteristics associated with a memory and determining whether sufficient evidence exists to label the candidate item as coming from one source versus another. Source-monitoring performance is generally (but not always) better when the contextual difference between the two alternatives is greater (e.g., Gruppuso, Lindsay, & Kelley, 1997; Lindsay, Johnson, & Kwon, 1991). For example, reality monitoring requires distinguishing between items that were self-generated versus other-generated. Performance on such tests is generally better than when the two sources are more similar to one another as, for example, when both were externally perceived or both were internally generated (e.g., Johnson & Raye, 1981; Marsh & Hicks, 1998).

One important issue in the source-monitoring literature concerns the manner in which source-specifying attributes are recorded into memory. Whereas some attributes are automatically encoded, others require attention in order to be stored successfully (e.g., Chalfonte & Johnson, 1996; Hashtroudi, Johnson, Vnek, & Ferguson,

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1994). Although relatively little empirical work has been focused on issues surrounding the binding of attributes into memory (but see Mitchell, Johnson, Raye, Mather, & D'Esposito, 2000; and also E. J. Marsh, Edelman, & Bower, 2001), we do know that older adults are less efficient at recording certain qualitative characteristics into memory (e.g., Henkel, Johnson, & De Leonardis, 1998; Johnson, De Leonardis, Hashtroudi, & Ferguson, 1995). We also know that confounding a particular speaker with a more distinctive context will improve source memory. For example, placing one person next to a potted plant and another next to colourful picture increases person discriminability at test (Johnson et al., 1995). Thus, more complex sources tend to be more easily discriminated from one another.

The specific question that we addressed in this study concerned whether focusing attention towards a particular source attribute during learning would change memory performance for a different source attribute. For example, people often observe pictures in a magazine or on the internet at their computer. In a standard source test, participants would be asked to specify whether items were studied in the magazine, on the computer monitor, or were brand new. This study assessed whether people who were informed that their memory would be tested in this fashion for the location (i.e., medium) information would have any different memory for a different attribute of the context such as whether the pictures were seen in colour or in black and white. Theoretically, knowledge that one will be tested for a particular attribute should only increase memory for that attribute. One important exception to such a predicted increase would be if that particular contextual detail were automatically encoded anyway (e.g., Hasher & Zacks, 1979, 1984). In other words, we know of no theory that would predict worse memory for an attribute dimension that was intentionally learned, and only know of cases where incidental memory would be equivalent to intentional learning (e.g., Postman, 1964).[1]

By contrast, we predicted that the focus of attention towards a particular (to-be-learned) attribute could result in less attention being devoted to encoding a different contextual attribute. If so, then source memory may be worse for that attribute out of the focus of attention. Early support for this hypothesis was found by Bahrick (1954) who demonstrated that participants given a high incentive to learn the temporal details of items (i.e., serial order information) had worse memory for the second attribute of item colour as compared with a low-incentive condition. To the extent that incentive correlates with attention allocation, a trade-off existed in which intention to learn one attribute reduced memory for another attribute. More recently but in a similar vein, Jurica and Shimamura (1999) found that participants who focused their attention at generating answers to questions during learning had worse source memory for who asked them the question as compared with items that lacked the generation component during learning. Jurica and Shimamura labelled this outcome the *negative generation* effect on source monitoring. That effect suggests that attention focused at learning on a particular attribute could result in a different attribute being less likely to be recorded into memory. However, we do not know of any other theoretical or empirical boundary conditions that have been placed on the negative generation effect. According to a general (i.e., unitary resource) limited-capacity model of attention (e.g., Kahneman, 1973), the learning trade-off would occur only when encoding processes related to the to-be-learned attribute leave little or no capacity for encoding of other contextual details. As it relates to source-specifying details, that theory has gained some initial purchase from the empirical work performed by Bahrick and Jurica and Shimamura. Nevertheless, different combinations of attributes have yet to be assessed in a source-monitoring test, and that was precisely one of the goals of the present study.

On the other hand, knowing that source memory is going to be tested may sensitise participants to other contextual variations that occur during the encoding experience. In this case, knowing that one will be tested on a particular attribute dimension may increase memory for a different dimension of the context. Obviously, such an outcome would be consistent with a unitary resource model of attention if sufficient capacity remained after encoding the to-be-learned attribute. In addition, a model of attention

[1] Technically, cases have been reported in which standard free recall performance for items, but not contextual information, was worse following intentional learning instructions as compared with incidental learning. However, these cases have only occurred when intention to learn was combined with an orienting task that interfered with the strategies that participants wanted to adopt naturally (e.g., Craik & Lockhart, 1972). Because no orienting task was used in the current experiments, we do not consider any further cases in which intention to learn could reduce performance on the to-be-learned attribute.

that specified separate pools of attention might also be consistent with increased memory for a contextual dimension other than the to-be-learned one (e.g., Wickens, 1991; Wickens, Sandry, & Vidulich, 1983). In this case, learning an attribute in one modality would not tax attention for learning an attribute in a different modality, as long as those modality dimensions did not compete for the same small pool of resources. Obviously, the existing theories of attention do not uniquely specify the memorial fate of an attribute that is outside the focus of intentional learning. Consequently, neither the unitary nor the multi-modal theory can precisely guide the present investigation, and additionally, the data from this investigation could not be used as evidence in favour of one theory of attention over the other.

Despite this somewhat ambiguous theoretical state of affairs, the overarching point of this study was to discover any lawful relations that might exist between focused learning of a source attribute and memory for a different attribute that a learner is led to believe will go untested later. In this way, the present study is unique from other examinations of source memory in so far as it addresses issues concerning attentional focus and the original binding of information into memory in the first place. Because an inward versus an outward focus of attention may have different consequences for attributes outside that focus (Wippich, 1995), different combinations of attribute dimensions were tested in each of the three experiments. More specifically, Experiments 1–3 tested external–external, internal–external, and internal–internal source monitoring, respectively (Johnson et al., 1993). External attribute dimensions are those that are tangibly in the environment, such as the modality in which information appeared, whereas internal attribute dimensions are those that reflect mental or cognitive operations from elaboration. Therefore, the consequences were assessed to both external versus internal attribute dimensions from focused attention on either external versus internal attribute dimensions, albeit across experiments.

EXPERIMENT 1

In this first experiment, participants studied a series of black and white photos intermixed with coloured photos. This manipulation of the colour dimension was orthogonally crossed with whether they studied the photos in a three-ring binder or on a computer monitor. Three different groups of participants were tested who differed in what information they believed would be required later. In a control condition, we simply told them to learn the pictures for an unspecified memory test (i.e., our standard source-monitoring instructions). In a colour focus condition, we explicitly told people that we would test them on whether they studied the item as a black and white photo or one that was in full colour. In a location focus condition, we informed participants that they would be tested on whether the items were studied on the computer monitor versus in the binder. In actual fact, people had to answer both source questions for all items (i.e., both colour and location).

If focusing people on learning one source dimension reduces attention for learning another dimension, then worse memory should be observed for the attribute that was not specified in the instructions. This outcome would occur either because (a) insufficient resources exist to simultaneously learn both attributes in a single resource model of attention, or (b) location and colour both compete for the same pool of visuospatial resources specified in Wickens's (1991) theory of multiple pools of attention. On the other hand, learning a particular external contextual detail may increase binding of other external details into memory as well, and perhaps source memory would be improved for both external attributes relative to the control condition.

Method

Participants. A total of 75 undergraduates volunteered in exchange for partial credit towards a course requirement. Each participant was tested individually in sessions that lasted approximately 25 minutes. In each of the control, the location focus, and the colour focus learning conditions 25 volunteers were tested. Assignment to conditions was on a rotating basis.

Materials and procedure. Coloured photographs were taken from a series of *National Geographic* magazines. The photos selected were chosen on the basis of whether a one-word label describing it could be easily generated (e.g., *boats*, *bear*, etc.). These 60 items were scanned into the computer. Half of the photographs were subsequently transformed into 8-bit grey-scale so that they were still almost as pictorially detailed as the colour photos but obviously in black and white rather than coloured. The colour manipulation was orthogonally crossed with the location of the picture being shown on the computer monitor versus in a three-ring binder. Thus, 15 items were shown from each of the four combinations of sources (computer–colour, computer–B/W, binder–colour, binder–B/W). The order in which they were shown was truly random (i.e., not blocked by computer vs binder location) and items were rotated through all combinations of sources. Each picture had a one word label and all participants regardless of learning condition had been asked to pay attention to the label accompanying the picture. The software controlling the experiment either chimed and presented a picture or presented an auditory message ‘‘Study the next picture in the binder’’. Participants had been informed that upon hearing that instruction they should turn to the next picture in the binder beside the computer monitor (the first page of the binder was blank). Pictures in the binder were encased in sheet protectors as a means of preserving them as well as ensuring that it was easy to turn one and only one page at a time. All items were studied for 7 seconds each.

The critical manipulation of attentional focus came at the beginning of the experiment when participants were handed written instructions specific to their condition. In the control condition, participants were informed that we were interested in their memory for pictures and the labels accompanying them, and that consequently, later they would receive a memory test. No other information was provided. In the colour focus condition, people were also told that their memory for whether the items were depicted in black and white versus colour would be tested later and that they should pay particular attention to this dimension of the picture. In the location focus condition, the learning emphasis was placed on the distinction between the monitor versus the binder as the important dimension to remember. Other than these learning instructions that manipulated what kind of test was to be expected, participants were treated identically. Prior to learning, the experimenter verbally reiterated the instructions specific to a participant’s assigned condition. Following learning, all participants were given a word-find distractor task for 5 minutes, which was timed with a stopwatch. Following that task, they were led from the computer that they had been working with (which had a 17″ colour monitor) to a different computer that had only a 15″ black and white monitor. They were seated with their backs to the previous learning environment. These procedures reduced the opportunity for any external cues associated with the equipment used during learning to affect memory performance. Here their memory for the source attributes was assessed on a self-paced test.

All participants in all learning conditions were tested identically. The 60 word labels from the learning session were randomly intermingled anew for each participant tested with 30 brand new labels. A word label appeared in the centre of the monitor and participants had to make two source judgements, one for the colour dimension and one for the location dimension. For half of the test trials, the location was queried first and colour second, and for the other half the order was reversed. The first query appearing below a word label required a three-alternative response (e.g., binder, monitor, or new). If the participant specified that the item was old (i.e., binder or monitor), the second query was a two-alternative judgement (colour versus black and white). Labels were placed on the keys of the keyboard clearly delineating which key indicated which response.

Results and discussion

Unless specified otherwise by a p value, statistical significance does not exceed chance by the conventional 5% throughout this article. We report average inferred recognition hit rates and average conditionalised source-monitoring (ACSIM) scores for each of the colour and location attributes for the three conditions tested. The former is simply the proportion of old items claimed to be old without regard to claims about their original origin. The latter is computed as the proportion of items identified as old that were correctly assigned to their original source. For example, the numerator of the ACSIM score for the colour dimension represents the number of items correctly called colour plus those correctly called black and white, whereas the denominator is the number of old items called old without regard to the source specified. We have chosen to summarise performance in this fashion because providing 9-cell tables for each attribute and each condition tested would result in cognitive overload (i.e., a minimum of 54 means being reported for each experiment). The inferences we have drawn from the ACSIM scores are not fundamentally different from those that would have been drawn if all of the minutiae had been reported, which happens to be one beauty of this summary measure of performance (cf. Bayen, Murnane, & Erdfelder, 1996).

The data are summarised in Table 1 with the first column representing the inferred old–new hit rate for the three conditions tested. As can be seen there, manipulating the focus of attention did not affect old–new detection, $F(2, 72) < 1.0$, n.s. That outcome is consistent with observations that intent to learn is often not an important variable in learning (cf., Craik & Lockhart, 1972; Postman, 1975). However, the veracity of those older observations clearly depends on the manner in which memory is assessed because source-monitoring accuracy for the location dimension did covary with focus of attention during learning, $F(2, 72) = 5.61$. Participants told to expect a test on binder versus monitor information had higher source discrimination accuracy than the control condition for location information, $t(48) = 3.34$. In addition, the colour focus group showed no such benefit to being able to specify location information as compared to the control condition, $t(48) < 1.0$, n.s. The equivalent performance of the colour focus group to the control condition suggests that source information about a particular external attribute is not necessarily lost just because attention is focused on a different external attribute during learning.

TABLE 1
Proportion of correct old–new detections and average conditionalised source-monitoring scores (ACSIM) in Experiments 1–3

Focus of attention	*Old–new recognition*	*Location ACSIM*	*Colour ACSIM*
	Experiment 1		
Control	.80 (.02)	.62 (.02)	.67 (.02)
Location	.77 (.02)	.71 (.02)	.68 (.03)
Colour	.77 (.03)	.64 (.02)	.76 (.02)
	Experiment 2		
Focus of attention	*Old–new recognition*	*Person ACSIM*	*Modality ACSIM*
Control	.80 (.02)	.57 (.03)	.71 (.02)
Person	.86 (.01)	.69 (.02)	.78 (.02)
Modality	.84 (.01)	.63 (.03)	.76 (.03)
	Experiment 3		
Focus of attention	*Old–new recognition*	*Person ACSIM*	*Judgement ACSIM*
Control	.91 (.01)	.56 (.03)	.76 (.03)
Person	.95 (.01)	.70 (.02)	.80 (.02)
Judgement	.93 (.01)	.54 (.03)	.76 (.03)

Standard errors are in parentheses.

The source discriminations on the colour dimension also differed by learning focus condition as well, $F(2, 72) = 5.82$. Similar to the location discriminations, the colour focus condition performed better than the control condition, $t(48) = 3.06$, whereas a location focus at study neither decreased nor increased colour discriminations, $t(48) < 1.0$, n.s. Therefore, for each of the two source discriminations, focusing attention on a particular external attribute increased participants' memory for that attribute while simultaneously leaving their memory for the other external attribute entirely intact. Such results would make perfect sense if location information were bound in to memory automatically (e.g., Hasher & Zacks, 1984), but unfortunately, some have strongly challenged such a claim (e.g., Naveh-Benjamin, 1987; Naveh–Benjamin & Jonides, 1985). To our knowledge, no one has claimed that colour information is encoded automatically, and claims have been made to the contrary (e.g., Chalfonte & Johnson, 1996; and as discussed earlier see Bahrick, 1954). Therefore, regardless of whether these two external attributes are bound automatically or not, focused attention on a contextual detail during learning does not appear to reduce information about other contextual attributes.

In terms of the theories of attention discussed earlier, location and colour information obviously do not compete during learning, *per se*, for either a unitary pool of attention (Kahneman, 1973), or for a single pool of more specialised resources (Wickens, 1991). Because colour and location are both spatio-temporal details in the source-monitoring framework (e.g., Johnson et al., 1993), the present experiment demonstrates one case in which there is neither a cost nor a benefit to learning a similar (i.e., external) attribute that is ostensibly outside the focus of attention.

EXPERIMENT 2

Marsh and Hicks (1998) found that source accuracy for a seen source depended on the other source with which it was paired. Therefore, the equivalent benefits on both location and colour in the previous experiment are unlikely to be found for every combination of sources tested. In particular, location and colour are both external attributes, and focusing attention on one attribute in the external dimension may not reduce encoding for a different external attribute. A very different outcome could occur if one attribute is external and the other is internal. In the source-monitoring framework, performance on external attributes is determined by assessing spatio-temporal details whereas performance on internal attributes is governed by the amount of cognitive operations (i.e., records of elaboration, imagination, and so forth). Thus, a focus on an external attribute could concomitantly reduce encoding of internal thoughts and a focus on internal dimensions could reduce encoding of external details (for a similar discussion see Wippich, 1995). Contrasting internal versus external sources is an extension of the reality monitoring distinction (e.g., Johnson & Raye, 1981; Johnson, Raye, Foley, & Foley, 1981) and was tested in this next experiment.

The external modality dimension was manipulated as seen versus heard information, and the internal dimension was manipulated as which of two imaginary people was associated with the items. The seen–heard manipulation is clearly an external perceptual discrimination, whereas the person dimension probably reflects discriminating internal cognitive operations. Marsh and Hicks (2002) used the imaginary person discrimination task in five experiments and found that participants would spontaneously generate rationales for why items were associated with one imaginary person versus another. In the process, the two imaginary sources developed idiosyncratic personas that were generally unique to each participant. Because there were no actual people to discriminate between, we assumed then (and do so here again) that accurate source monitoring can only be based on internal thoughts and records of these spontaneous and idiosyncratic elaborations.

Method

Participants. A total of 75 undergraduates volunteered in exchange for partial credit towards a course requirement. Each participant was tested individually in sessions that lasted approximately 25 minutes and 25 volunteers were assigned on a rotating basis to each of the three learning focus conditions.

Materials and procedure. This experiment was virtually identical to the previous experiment except in the following respects. All of the items were common, concrete nouns such as *vase* and *book*. The cover story for the experiment was that two imaginary people named Sally and Edwin would be giving the participant objects (see Marsh & Hicks, 2002). As in the previous experiment, there were 60 items at study and half were associated with each imaginary person. Crossed orthogonally with the person dimension was the presentation modality as seen versus heard. When an item was seen, the object name appeared in the centre of the participant's computer monitor with the words "From Sally" or "From Edwin" printed two lines directly beneath it. When this information was to be heard, the software controlling the experiment wrote this information to the experimenter's computer behind the participant who could not see it. The experimenter, who could not be seen by the participant, then read this information aloud. Items were presented at a 5-second rate during the encoding phase. The order of presentation was random for each participant tested.

After a 5-minute distractor period, participants made modality and person source judgements on all 60 old items and 30 brand new items. The test order was randomly generated anew for each participant as well. The manner in which participants were queried was identical to Experiment 1 with the exception of the response options (e.g., seen, heard, or new). The critical manipulation came before the study sequence. The control condition group was asked to study items for an unspecified memory test. The modality focus group was informed that their memory would be tested for whether they had read an item on the computer screen or whether the experimenter spoke it aloud. The person focus condition group was informed that we would test them on whether Sally or Edwin had "given" them a particular object. In all other respects, the procedures used in this experiment were the same as used in the previous one.

Results and discussion

The data are summarised in the middle portion of Table 1. Inferred old-new recognition performance was influenced by the focus of attention during study, $F(2, 72) = 6.39$. Being informed of the nature of the test helped participants in both the modality and person focus conditions to identify more old items as old compared to the control condition: both $t(48)$, $p < .05$. However, person discrimination accuracy was affected independent of old–new detection, $F(2, 72) = 6.72$. Similar to Experiment 1, participants informed that their memory would be tested on the person associated with items performed significantly better than those assigned to the control condition, $t(48) = 3.71$. Participants who focused their attention on the modality numerically increased their person discrimination over those in the control condition, but not statistically so, $t(48) = 1.67$, $p = .10$. Evidence for asymmetrical performance was obtained on the modality discriminations, $F(2, 72) = 3.49$. As expected from the results described thus far, those who were focused on learning modality information performed marginally better than those in the control condition, $t(48) = 1.68$, $p = .09$. However, so did those people who were expecting a test on the particular person, $t(48) = 2.88$. Therefore, some evidence was obtained in this experiment that knowledge that one source attribute would be tested *increased* people's memory for a different source attribute that was ostensibly not the focus of their attention during learning.

Together, the data from both Experiments 1 and 2 suggest that focused learning of a particular contextual attribute does not decrease memory for a different contextual attribute. The data are more equivocal on whether it can improve memory for a different attribute, but this experiment is at least suggestive that knowing one will be tested on a particular contextual attribute can increase memory for a different attribute, at least with the two internal–external dimensions tested here. Clearly, the cognitive processes used to encode (internal) person information appear to be capturing (external) modality information. By contrast, the cognitive processes used to encode modality are not as sensitive to capturing person information.

There may be several reasons for this apparent asymmetry, although we acknowledge that we have only conjecture at this point. First, knowledge that cognitive operations will be tested later may engage learning processes that are more complex, elaborate, or attention-demanding as compared with knowledge that external dimensions will be tested. Consequently, the external seen–heard dimension may receive some *overspill coding* (e.g., Craik & Tulving, 1975) in the person focus condition. By this account, knowledge that any internal source dimension will be tested may increase memory for external attributes. Second, and by a different account, the apparent increase in external modality information may be a direct consequence of the particular internal dimension chosen, namely, person discrimination. After all, encoding processes used to learn information about people are more complicated (e.g., Srull & Wyer, 1989; Wyer & Srull, 1981). Because the context in which a person is encountered may be viewed as extremely important to later interaction, this information may be preferentially associated to the person information. What ever the precise reason, focused attention on an internal dimension does not reduce memory for an external dimension, or vice versa. In fact, there may be an increase in memory.

EXPERIMENT 3

Experiments 1 and 2 have tested, respectively, two external dimensions or an extension of the internal–external dimensions used in reality monitoring. Therefore, in this last experiment two source discriminations were assessed that both involved cognitive operations. We retained the person manipulation from the previous experiment but replaced the modality manipulation with an orienting judgement. The orienting judgement was to rate half of the items for frequency of encounter and half for pleasantness. Because focus of attention on one attribute did not reduce memory in the previous two experiments, we did not expect that that outcome would occur with the two internal source dimensions tested in this experiment. Rather, the question of fundamental interest became whether there would be a unique improvement for one attribute dimension if participants knew that it would be tested later as opposed to a more general improvement found in both dimensions.

Method

Participants. A total of 60 undergraduates volunteered in exchange for partial credit towards a course research requirement. Each participant was tested individually in sessions that lasted approximately 30 minutes, and 20 volunteers were assigned to each of the three focus conditions.

Materials and procedure. The objects and person aspects used in Experiment 2 were retained in their entirety. The manipulation of orienting task replaced the seen versus heard dimension tested in the previous experiment. All information was presented visually in this experiment. As each object and person information was displayed, people had to rate items for either how pleasant they were or how frequently they had encountered them in the last 2 weeks. The specific query appeared under the item and person information during learning. Ratings were obtained on a 7-point Likert scale, and if participants made their orienting judgement before 5 seconds had elapsed, the software waited until a full 5 seconds had elapsed before advancing to the next study trial.

Source memory was tested in an identical manner to that described previously with the exception that in this experiment participants made orienting judgements (i.e., frequency, pleasantness, or new) in addition to person judgements. Prior to learning, participants in the judgement focus condition were informed that we would test their memory later for what judgement they made on each item. The other two conditions received the instructions described for Experiment 2.

Results and discussion

The data are summarised in the lower third of Table 1. Although the numerical differences were slight, learning focus did significantly change inferred old–new recognition (i.e., detection), $F(2, 57) = 3.34$. As in Experiment 2, knowledge of how memory would be tested helped participants in the person and judgement conditions to identify more old items as old. However, independent of the level of old–new recognition, the learning focus affected person discrimination as well, $F(2, 57) = 10.84$. Person discrimination was better in the person focus learning condition than in the control condition, $t(38) = 3.66$. That aspect of performance nicely replicated Experiment 2. By contrast, the judgement focus during study did not affect person memory as compared to the control group, $t(38) < 1.0$. In this case, performance was different from Experiment 2. In that previous experiment, (external) modality focus numerically increased (internal) person memory, but in this experiment (internal) judgement focus did not result in even a numerical benefit to person memory. Focus of attention did not affect judgement discriminations at all, $F(2, 57) < 1.0$. To what we should attribute this null effect is unclear. However, participants may have believed that this was the most important aspect of the task because they were required to type their ratings into the computer. Or perhaps, these orienting tasks left very diagnostic memorial details that were recorded despite instructions in the person focus condition that one's memory would be tested later for the person information. After all, these ACSIM scores are collectively among the largest in all of Table 1.

As in the previous experiments, there was no evidence that focusing on learning one contextual detail detrimentally affected learning of a different detail. Unlike Experiment 2, there was also no evidence that focusing on one dimension improved memory for a different dimension. However, we did replicate with person memory that focused attention on who was associated with an item improved memory for that dimension. We turn now to consider more generally what these experiments demonstrate about binding source-specifying details into memory.

GENERAL DISCUSSION

At the outset of this inquiry we genuinely believed, based on Jurica and Shimamura's (1999) results, that focused attention towards one contextual attribute during learning would reduce memory for a different attribute (cf. Bahrick, 1954). Obviously, our intuitions were wrong. The processes that record contextual details into memory appear to benefit from focused attention towards particular attributes, but that benefit does not result in any detriment to binding other contextual details into memory. In fact, in Experiment 2, which tested internal–external dimensions, some weak evidence was found that focusing attention towards one contextual attribute can improve memory for a different attribute. One way to conceive of these results is that all contextual details are recorded into memory rather automatically under standard learning conditions. Extra processing during learning may improve memory for a particular detail but it does not have negative consequences for binding of other contextual details. Importantly, the *absence* of negative consequences was true no matter what combination of internal versus external discriminations was required.

This conception is entirely consistent with those who argue that people have many smaller pools of attentional resources as opposed to one central set of attentional resources (e.g., Pashler & Johnston, 1998; Wickens, 1991; Wickens et al., 1983). By this account, we process visual, auditory, and spatial information (to name a few) simultaneously using different pools of attention. Therefore, increasing attention towards, say, the spatial aspects of items would not necessarily limit those resources that could be deployed towards encoding visual, auditory, or even internal characteristics. Although this particular theoretical account handles our data, it does not explain Jurica and Shimamura's (1999) finding of a negative generation effect on source memory. However, what participants were generating in their study were answers to questions about themselves (e.g., their favourite food, etc.). In that case, memory had to be searched in order to find the appropriate answer. Perhaps memory works in such a fashion as to make it impossible (or more difficult) to simultaneously retrieve and encode information. After all, there is evidence that it is difficult to recall two memories at the same time (Rohrer & Pashler, in press; Rohrer, Pashler, & Etchegaray, 1998). What this observation suggests is that whenever cognitive processes are directed inward towards accessing reflective information, encoding of contextual details may suffer. This conjecture fits well with Johnson, Nolde, and De Leonardis's (1996) finding that judging the intensity of one's own emotional reaction to statements during encoding decreased source performance as compared with judging how someone else might react.

Unfortunately, this conjecture cannot account for the positive generation effect found by E. J. Marsh et al. (2001). In those studies, generating category exemplars from category labels and first letters (e.g., *Bird–P*) resulted in better context memory for which of two rooms or which of two colours or fonts the studied items were printed in. Therefore, it cannot be the case that any kind of attentional manipulation deflects processing away from encoding contextual details. To date, only a self-reflective attentional manipulation during learning has been found to reduce memory for source-specifying attributes (i.e., Johnson et al., 1996; Jurica & Shimamura, 1999). Because the attentional direction we manipulated towards one of the two attributes cannot be classified (easily anyway) as inwardly reflective, as in generating answers to personal questions or judging one's own emotional reaction, it did not reduce source memory. Another possibility is simply that retrieving personal information is a more complicated diversion of attention than is generating category exemplars. If this were true, perhaps dividing attention during learning and manipulating attentional focus would be a fruitful avenue to pursue. Obviously, when positive versus negative generation effects are obtained for contextual attributes needs to be explored more systematically.

Nevertheless, the present results are clear. A focus on learning one contextual attribute does not reduce source memory for a different attribute. Thus, a learning manipulation focused towards one attribute leaves binding intact for other contextual details. Although we have not tested all manner of qualitative characteristics, the results were fairly uniform in their convergence on this simple point. This immunity of focused attention on binding other features into memory is probably an adaptive quality of the cognitive system. At the time we experience an event we may focus our attention on what we believe will be important later on, only to find that memory for a different contextual attribute will serve us better. If nothing else, the present results support the idea that source-monitoring processes are amazingly resilient even in the face of what can be considered to be incorrect allocations of attention during encoding.

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