The Effects of Time-Induced Stress on Making Inferences in Text

Comprehension

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Abstract

This study aims to investigate the effects of time-induced stress on making inferences in text comprehension, and to account for these effects in terms of working memory processing limitations. Using a program called *Hypercard*, a narrative text was presented to 66 Year 6 participants (aged 10-11 years) on a series of computer screens. Participants were either assigned to a control condition (n= 17), counterbalanced by level and gender, in which they could, themselves, control the rate of presentation of the text, or to one of three 'stress' conditions. For the stress conditions, a form of calibration was carried out, based on the results from a preceding pilot study. The first speed condition presented the text at a rate of 2.5 words/second, the second speed condition presented the text at a rate of 3.0 words/second, and the third speed condition presented the text at a rate of 3.5 words/second. Participants with a TA reading ability level of 3 were assigned to the first speed condition (n= 15), participants with a TA reading ability level of 4, to the second speed condition (n = 17), and participants with a TA reading ability level of 5, to the third speed condition (n = 17). After reading the text, participants completed verbal and numerical working memory tasks, followed by 18 comprehension questions, which could be categorised as either retrieval-based or inference-based questions. Results illustrate an effect of level: the ability to make inferences increases with an increase in TA reading ability level. With respect to an effect of condition on question type, this was not significant. Qualitative analyses reveal certain trends. These findings are interpreted in the terms of the theoretical construct of working memory processing limitations.

Introduction

The aims of this study are to investigate the effects of time-induced stress on children's text comprehension, with a particular focus on making inferences. This study builds upon an earlier-conducted pilot study, which investigated the effects of time-induced stress on children's text comprehension in more general terms (Kiwan et al., 1999). This pilot study was exploratory in nature, in an attempt to identify specific aspects of text comprehension that may suffer under time-induced stress. One key finding from this pilot study was that children relied heavily on the use of schemas in their recall and comprehension of the text, with preliminary evidence to suggest that this effect was increased under time-induced stress. Schemas are memory components that are derived from extracting information of a stereotypical event, person or action over a number of occasions. The reader makes inferences whilst reading the text, by integrating this knowledge-based information with information from the text. It is clear that schemas will therefore strongly affect text comprehension (Gerrig, 1986). This study aimed to investigate the effect of time-induced stress specifically on making inferences.

The hypothesis that time-induced stress may affect the ability to make inferences draws on three main inter-linked theoretical perspectives. Firstly, research on comprehension difficulties in children has shown that these difficulties can occur at both higher and lower levels of processing (Yuill & Oakhill, 1991). Difficulties in making inferences are likely to be processing difficulties at a higher level of processing, that is, at the level of the text.

Secondly, there is considerable research in the field of working memory and text comprehension. Working memory has been defined as a limited capacity system that simultaneously stores and processes information (Baddeley, 1986). Comprehension difficulties have been explained in terms of this limited capacity processing system. Daneman and Carpenter's (1980) seminal study provided empirical evidence that individuals with larger working memory processing capacities performed better on text comprehension measures. In addition, research has been conducted relating working memory capacity to making inferences, in particular (George et al., 1997; Singer & Ritchot, 1996; Walczyk & Raska, 1992; Yuill & Oakhill, 1991).

Thirdly, the effects of stress on various aspects of cognitive performance have been widely studied (Calvo et al., 1992; Hockey, 1993; Kellogg et al., 1999; Tolhill & Holyoak, 2000). The negative effects of stress have been interpreted in terms of limited working memory processing capacity. Stress has been conceptualised in various ways, that can be broadly categorised in terms of trait anxiety (Calvo et al., 1992; Kellogg et al., 1999), or state anxiety (Tolhill & Holyoak, 2000). Another conceptualisation of stress comes from Brown and Markman (1991), who have conducted a number of studies to identify stressful conditions in a classroom context. They define a stressful condition as one in which "…linguistic and contextual factors interact so that the linguistic message is relatively easy or relatively more difficult to understand" (Brown & Markman, 1991, p.47). In our study, stress has been conceptualised in terms of time. This is a form of state anxiety: it is a temporary condition induced by a certain trigger.

This study presents a narrative text that children are required to read from the computer screen. The text is either presented in a control condition, in which children can control the rate of presentation of the text, or in a 'stress' condition. After reading the text, children complete a verbal and a numerical working memory task, before orally answering a series of

18 questions. These questions can be broadly categorised into either retrieval-based questions, or inference-based questions. This study investigates whether there is a differential effect of time-induced stress on question type (retrieval-based versus inference-based), and also if this stress differentially affects children of varying reading abilities.

This study attempts to replicate the link between working memory and text comprehension, but to focus more specifically on making inferences. Investigating the effects of time-induced stress will be of particular interest in the context of increasing attention on national assessment. There have been numerous reports in the national press raising the issue of the effects of stress on examination performance. In addition, the methodological use of the computer to present the text in this study is likely to become of growing relevance, given that computers are likely to be increasingly used in educational assessment. It will be important to understand processes of children's text comprehension in this context, and the effects of stress on these processes.

Literature Review

What is text comprehension?
Learning to read is one of the most important tasks that children face at school. When we say that we are reading a text, there is usually the implicit assumption that we also understand what we are reading. This is not surprising given that the ultimate goal of reading is to extract meaning from it. It is thought that the reader builds a 'mental model' of the situation described in any given text, and in order to obtain this representation, the reader is involved in processing at a number of levels.

Difficulties in text comprehension may occur at mainly three different levels of processing: at the level of the word, at the level of the sentence, and at the level of the text (Yuill & Oakhill, 1991). In this study, we are focussing on processing at the level of the text. These processes include making inferences, and integrating the meanings of individual sentences to form a cohesive model of the text. Oakhill (1996) noted that those readers who have difficulty comprehending a text also have difficulty making inferences. This does not appear to be a memory problem, as even when the text is available for children to re-read, the less-skilled comprehenders performed less well on inferential questions in comparison to the skilled comprehenders (Oakhill, 1984). In this study, we attempt to evaluate evidence relating to processing difficulties at the level of the text: if time-induced stress puts increased pressure on processing during a text comprehension task, then such a condition might be expected to produce increased difficulties in making inferences in particular during such a text comprehension task.

What is an Inference?
Much of research relating to reading until the 1960s focused on the role of syntax in text comprehension (Oakhill & Garnham, 1988). Bransford, Barclay and Franks (1972) highlighted the importance of making inferences in text comprehension, emphasising that text comprehension is a constructive and integrative process, which requires the construction of the intended message from text-based and knowledge-based information.

Readers often have to make inferences because of incomplete knowledge in a text in their attempts to comprehend that text. In order to make inferences, the reader has to be able to use knowledge stored in memory, referred to as a 'schema' (Bartlett, 1932). Schema theory

proposes that information is gathered together into meaningful units, and that we have schemas for most things that we have experienced or encountered. Schemas allow the reader to generate expectations and make inferences as they read a text, and strongly affect text comprehension and recall (Gerrig, 1986). Skilled comprehenders are more likely to use their prior knowledge to facilitate comprehension than are less-skilled comprehenders (Oakhill, 1984; Spires & Donley, 1998). It will be interesting to explore the effects of time-induced stress on these processes, given the preliminary findings from the pilot study. It was hypothesised that, under time-induced stress, children would be particularly likely to rely on commonly-held schemas in their comprehension of the text. This hypothesis is related to an understanding of the characteristics of working memory, which will be addressed at a later point in this paper.

There are a number of different approaches to classifying types of inferences in the research literature (Casteel, 1993; Graesser et al., 1994; Oakhill & Garnham, 1988; Singer, 1988). One type of approach (Casteel, 1993; Durgunoglu & Jehng, 1991; Oakhill & Garnham, 1988) broadly categorises inferences into two main types: 'necessary' and 'elaborative' inferences. (These are also referred to in the literature as 'backward'/'bridging' and 'forward' inferences, respectively.) A 'necessary' or 'backward' inference is an inference that is necessary for a full interpretation of the text. This type of inference integrates separate propositions within the text in order to construct a coherent representation, and it is generally thought to be made during the reading process. In contrast, 'elaborative' or 'forward' inferences are not necessary for an understanding of the text, but rather, they refine the representation. It is thought that these inferences are not usually made during the reading process, but instead are made at retrieval (Durgunoglu & Jehng, 1991).

The distinction between 'necessary' and 'elaborative' may be useful in the context of investigating the effect of time-induced stress on making inferences. In our study we have chosen to focus predominantly on necessary/backward inferences, given that these are thought to occur on-line, and will be relatively more susceptible to effects of time-induced stress.

The role of working memory in text comprehension
When a reader integrates information from two sentences in constructing a mental model, the information from the first sentence must be available for integration when the second sentence is being read. This type of memory that has the ability to simultaneously store and process information is referred to as 'working memory': it is a limited-capacity memory system (Baddeley, 1986; Daneman, 1987). The vast amount of research that has been conducted on making inferences in text comprehension has shown that it is much harder for less-skilled comprehenders to integrate information from different parts of the text than it is for skilled comprehenders. This problem may be related to working memory.

Daneman and Carpenter (1980) hypothesised that individuals with a larger working memory capacity would be able to maintain more information actively than would individuals with a smaller working memory capacity. They developed a 'reading span' task that requires participants to read increasingly longer sets of unrelated sentences, ranging from two sentences to five sentences, and then to recall the last word of each sentence in the set. This task requires participants to simultaneously process and store information. A strong correlation was found between text comprehension and reading span in adults, which had not been previously shown with traditional word span and digit span measures. It has been suggested that this is because these measures are merely measures of storage capacity in

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short-term memory, whereas the reading span task was thought to tap a general processing capacity (Daneman, 1987).

There has been disagreement over whether the reading span task taps a general processing capacity, or whether it merely correlates with text comprehension because it shares a verbal component (Yuill & Oakhill, 1991). There have been attempts to resolve this by introducing working memory measures in other domains, for example, numerical or spatial domains (Swanson & Berninger, 1995; Waters & Caplan, 1996; Yuill et al., 1989). For example, Yuill, Oakhill and Parkin (1989) used a working memory measure based on Daneman and Carpenter's (1980) reading span task, but which instead used lists of three-digit numbers, and which were presented to children with either two, three or four numbers in each list. They found a highly significant correlation between this working memory measure and comprehension ability. Yuill and Oakhill (1991) propose that text comprehension is related to a verbal-symbolic processor, rather than to a specifically language-based system.

Working memory and making inferences
There is a substantial body of research that aims to elucidate the relationship between working memory and inferences (George et al., 1997; Singer & Ritchot, 1996; Walczyk & Raska, 1992; Whitney et al., 1991). There is also a body of research relating to the question of *when* inferences are made, that is, whether they are made on-line whilst reading, or whether they are made afterwards at retrieval (Casteel, 1993; Durgunoglu & Jehng, 1991; Estevez & Calvo, 2000; Graesser et al., 1994; Yuill & Oakhill, 1991). There is general support in the literature for the argument that necessary/backward/bridging inferences occur online during reading, in contrast to elaborative/forward inferences that occur at retrieval.

Yuill and Oakhill (1991) propose that less-skilled comprehenders are less likely to draw inferences during reading, and so may have forgotten some of the original premises by the time an inference is required. This may be exacerbated by their smaller working memory processing capacities. Yuill and Oakhill (1991) further provide evidence that suggests that even when less-skilled comprehenders are given more reading time, this does not correspond with an incremental increase in making inferences. This is not the case for the skilled comprehenders who benefit from increased reading time. This suggests that the problem with less-skilled comprehenders lies in not knowing how to make most effective use of their time. Yuill and Oakhill (1991) suggest that less-skilled comprehenders may be less capable of drawing on appropriate knowledge and experience in making inferences, which in turn may be due to their smaller working memory processing capacities. We would therefore hypothesise that the speed condition in our study may have greater negative consequences for skilled comprehenders than for less-skilled comprehenders.

The effect of time-induced stress on performance
It becomes increasingly clear that, underlying the various different conceptualisations of stress, there is a common hypothesis that the negative effects of stress on a whole range of cognitive tasks can be understood in terms of working memory. In our study, we hypothesise that the role of prior knowledge in the form of schemas will be important, and that when under stress, children will be particularly likely to rely on commonly-held schemas in their comprehension of the text. However, due to possible processing limitations, they may exhibit difficulty integrating these schemas appropriately with text-based information.

Using the computer to investigate the effects of stress on reading processes and text comprehension

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This study uses the computer to explore the effects of stress on making inferences during text comprehension by presenting the text on a computer screen in a control condition, in which children can control the rate of presentation of the text, and in three speed conditions. This mode of presentation has a number of advantages. Firstly, stress is defined purely in terms of time. In this study, we are focusing on stress in terms of 'state', as opposed to 'trait', and in addition, the rate of presentation can be accurately and consistently controlled across all participants. Secondly, it has often been noted that the use of computers has a motivational effect on children. As a consequence, they are likely to be more engaged in the task, and it may also be that they will be less prone to test anxiety. Thirdly, in the near future, computers will be increasingly used in schools for assessment, and given that there are some differences in reading linear and non-linear text (O'Hara & Sellen, 1997: Wenger & Payne, 1996), studies investigating reading processes on the computer will be particularly relevant. This is an area of research that is likely to expand rapidly in the next few years.

Study Design

Participants
Participants were 66 Year 6 children – aged 10-11 years (35 boys, 31 girls) from 8 schools selected from the Cambridge area. Two of these children were pilot subjects. Approximately equal numbers of children assigned teacher assessment (TA) reading ability levels 3, 4, and 5 were selected. Year 6 children were chosen to take part in this study as they were considered to be old enough to familiarise themselves with the computer technology in a reasonable amount of time, whilst also being motivated and thus engaged with this mode of presentation.

Materials
1/ Text
A number of texts were reviewed, resulting in the selection of a narrative text entitled 'The Emerald Necklace'[1], which was adapted in terms of length and also for the specific purposes of this study – to investigate inference-making. Copyright
permission was obtained for the use of this extract in its adapted form on the computer for the purposes of this study. In addition, a practice text[2] was selected from the three practice texts that had been used in the pilot study.

2/ Computer program
A software program called 'Hypercard' was used, which can be programmed to present text at different speeds. The text is presented on a series of screens, one paragraph at a time. For each paragraph of the text, there is a visual indicator at the bottom of the screen so that the participants can monitor the time available to read what is on the screen (Kiwan et. al., 1999).

3/ Comprehension questions
A series of 18 comprehension questions[3] were developed, that can be categorised into 'retrieval-based' questions, or 'inference-based' questions. There are eight 'retrieval-based'

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[1] This extract is from 'English Alive', Teacher's Resource Level 5, Collins Educational (1995), and can be found in the Appendix.
[2] The practice text was an extract of considerably shorter length than the actual text.
[3] A full transcript of the questions can be found in the Appendix.

questions and ten 'inference-based' questions. Participants' oral answers to these questions were tape-recorded and then transcribed and coded[4].

4/ Working memory measures
In order to investigate whether working memory plays a role in the effects of time-induced stress on making inferences, participants completed both a verbal and a numerical working memory task[5]. The verbal working memory task is based on Daneman and Carpenter's (1980) reading span task.

Sentences chosen were approximately between 9-12 words long, and devised so that they would be appropriate in terms of content and vocabulary for Year 6 children. Sentence sets consisted of 2, 3, 4 or 5 unrelated sentences. The numerical working memory task is a numerical version of the Daneman and Carpenter (1980) reading span task, and like that in Yuill, Oakhill and Parkin's (1989) study. Number sets consisted of 2, 3, 4 or 5 three-digit numbers.

Design and Procedure
The four conditions were:
i) 'Control' condition, in which participants were able themselves to control the rate of presentation of the text. Participants were assigned randomly to this condition, and counterbalanced by level and gender (n = 17).
ii) Speed condition 1: 2.5 words/second. Participants with a TA reading ability level 3 were assigned to this condition (n = 15).
iii) Speed condition 2: 3.0 words/second. Participants with a TA reading ability level 4 were assigned to this condition (n = 17).
iv) Speed condition 3: 3.5 words/second. Participants with a TA reading ability level 5 were assigned to this condition (n = 17).

Participants were assigned to the speed conditions as described above based on findings from the pilot study. It was generally found that children with a TA reading ability level 3 found that the presentation rate of 2.5 words/second was quite challenging. It was decided that such a condition could be considered to constitute 'stress'. This was the case for TA reading ability levels 4 and 5 children at presentation rates of 3.0 words/second and 3.5 words/second respectively. This procedure, in effect, constitutes a type of calibration, and attempts to define 'stress' in terms of a challenging presentation rate for participants of different reading abilities. It was decided that this would be more appropriate than randomly assigning participants across the three speed conditions counterbalanced by level and gender, as what is of interest is the comparison between a normal reading condition and a 'stress' condition. In addition it would be inappropriate to place the lowest reading ability level children in a speed condition that is well beyond their capacities. Performance on the text comprehension measures would have been extremely low, and may also have been distressing for these participants.
The procedure[6] was explained to each participant, and then the practice text was presented[7] to each participant in the condition in which they were to receive the actual text. This

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[4] An example of a transcription, and the coding framework can be found in the Appendix.
[5] Please refer to the Appendix for a full transcript of these materials.

[6] Please refer to the Appendix for a transcript of these instructions.
[7] There were a total of two experimenters who administered the procedure.

presentation lasted approximately one minute, after which participants were asked if they felt comfortable with the condition. Participants were then presented with the actual text. After participants had finished reading this text (3-5 minutes), a delay was introduced to stabilise the memory of the text.

It is at this point that participants completed the verbal and numerical working memory tasks. Participants read out loud each set of digits/sentences, and then had to recall the last digit/word in each set. A microphone was clipped to the participant, and this was recorded on tape and later transcribed. Sets increased from two to five, with two different groups at each 'level'. This allowed participants two chances to show whether they were capable of recall at each 'level'. For example, if a participant incorrectly recalled one of the words in a sentence set of four on the first group, but then correctly recalled all four words on the second group, they would be assigned a score of four.

Participants were then told that they would be asked some questions relating to the story. They were asked 18 questions, which could be categorised as 'retrieval-based' or 'inference-based'. Again, responses to these questions were tape-recorded and later transcribed and coded. On completion, of the study, each participating school was given a £30 book voucher as a token of appreciation for taking part in the study.

Analyses
The following analyses have been conducted:
i) a number of analyses of variance, comparing performance on question type (retrieval versus inference), by TA reading ability, by gender, and by condition (control versus stress). In addition, t-tests on means for the totals on the two question categories were conducted between the control condition and the stress condition at each TA reading ability level.

ii) correlations between the verbal working memory task score and: TA reading ability, total score, and subscores on 'retrieval' and 'inference' questions. Correlations were also calculated between the numerical working memory task score and the above-mentioned variables.

iii) Item bias analyses were also conducted, investigating any differential effects of level, gender, question type, and condition on performance. Here, performance on an item is compared to expectation based on performance on all others: Observed – Expected = Residual (Pollitt, 1998).

iv) Rasch analyses were conducted as initial exploration of the data for further qualitative investigation. Rasch analysis is based on item response theory and is a probabilistic model. Taking into account question difficulty and person ability, it makes score predictions for each level (Wright, 1977).

v) Finally, in addition to questions being scored as 0 (incorrect), 1 (correct), or omit, additional coding of the types of responses were undertaken for those questions that exhibited a frequent number of a range of different responses. This allowed for a qualitative exploration of the data. Different 'correct' and 'incorrect' responses for these questions were coded if they appeared with reasonable frequency.

Findings and Discussion

Verbal working memory and numerical working memory

The tablebelow shows means on the verbal working memory (wm-w) task and on the numerical working memory (wm-n) task by TA reading ability level:

Table 1: Mean scores on working memory tasks by TA reading ability level

Working memory task	TA Reading Ability Level		
	3	**4**	**5**
wm-w	3.29	3.69	3.95
wm -n	3.14	3.58	3.42

Analyses of variance show a significant effect of level, $F = 4.327$, $p < 0.05$, for wm-w; $F = 3.228$, $p < 0.05$ for wm-n. T-tests were conducted and both wm-w and wm-n were found to be statistically significantly different between levels 3 and 4 ($t = -1.990$, $p < 0.05$; $t = -2.413$, $p < 0.05$ respectively), but not between levels 4 and 5. In fact, it can be seen that the mean wm-n score for level 5 participants is in fact lower than the mean score for level 4 participants.

A number of correlations were computed investigating the strength of relationships between wm-w, wm-n and: level, total score on the comprehension test, total score on the inference-based questions, and total score on the retrieval-based questions:

Table 2: Correlations between working memory task scores and TA reading ability level, and test score, and subcomponents of inference and retrieval

Working memory task	TA Reading ability level	Total test score	Inference score	Retrieval score
wm-w	0.344**	0.332**	0.000	0.112
wm-n	0.188	-0.040	-0.035	-0.029

** indicates correlation is statistically significant at the 0.01 level.

This clearly shows that the numerical working memory measure does not correlate with TA reading ability level or total comprehension test score. This is in contrast to wm-w, which shows a statistically significant positive correlation with both TA reading ability level and total comprehension test score. This result does not support the hypothesis that the processing that occurs during text comprehension reflects a general rather than a more specific verbal processing capacity. This finding contrasts with the results of Yuill, Oakhill and Parkin (1989), who noted a significant correlation between this numerical working memory measure and comprehension ability.

These results also do not replicate the finding of a significant correlation between working memory processing capacity and the ability to make inferences. Yet it is interesting to note that there is a statistically significant correlation between wm-w and wm-n ($r = 0.318$) which suggests that they are not reflecting processing in totally discrete domains. Preliminary observations suggest that for at least the verbal working memory measure, an increase in working memory capacity results in an increase in scores on inference-based and retrieval-based questions.

Gender Differences

There were no statistically significant differences between the performance of boys and girls on the comprehension test as a whole, or on the subcomponent scores of either the retrieval-based questions or the inference-based questions. This was also supported by the results of an item bias analysis conducted on each question. This analysis found that none of the items were biased against the person criterion, gender.

TA reading ability differences
An item bias analysis was also conducted for TA reading ability level. This analysis found that none of the items were biased against the person criterion – TA reading ability level. However, when the items are grouped into the subcomponents, inference and retrieval, based on summing scores on all the inference-based questions, and all the retrieval-based questions respectively, certain trends emerge. Analyses of variance show an effect of TA reading ability level on retrieval questions (F = 2.443, p < 0.05), and total score (F = 2.317, p < 0.05). In addition, there is a trend for increased scores on inference-based questions with an increase in level, even though this is not statistically significant. This can be seen in the table below:

Table 3: Table of means on inference, retrieval and total test

TA Reading ability level	'Inference'	'Retrieval'	Total test score
3	6.81	2.71	9.58
4	7.35	2.77	10.12
5	8.47	3.58	12.05

In fact, the correlation between TA reading ability level and inference of r = 0.299 is statistically significant, p < 0.05. The correlation between TA reading ability level and total test score is also statistically significant (r = 0.332), p < 0.05. These correlations are slightly lower than those found in previously conducted studies (Yuill & Oakhill, 1991). Nevertheless, the significant correlation on the inference questions supports findings (QCA, 1999) that the ability to make inferences is a key discriminating variable between children at levels 3 and 4 in particular.

Effects of condition (control/stress) on question type category (inference/retrieval)
Analyses of variance show an effect of condition on performance on retrieval questions, F = 2.545, p < 0.05. T-tests were also conducted to compare means between levels 3 and 4, and 4 and 5 respectively. The table on the following page shows a comparison of means by condition and by TA reading ability level:

Table 4: Table of comparison of means in control condition with means in stress condition for each TA reading ability level by question type

TA reading level	Inference		Retrieval		Total score	
	control	stress	control	stress	control	stress
3	8.14	5.87*	3.43	2.33	11.57	8.20*
4	9.17	6.82*	3.83	2.47*	13.00	9.29*
5	8.75	8.47	4.25	3.29	13.00	11.76

*indicates a statistically significant difference between control and stress condition.

At level 3, t = 3.258, p < 0.05 for inference questions; at level 4, t = 2.393, p < 0.05 for inference questions, and t = 2.257, p < 0.05 for retrieval questions. At level 5, the differences in performance between the control and stress conditions are not statistically significant. It must be noted that these figures should be interpreted with caution, and are inconclusive, given the small numbers at each level in the control condition, in comparison with the stress condition. It does suggest, that the effects of stress may affect the lower ability level children to a greater extent than the higher ability level children.

A qualitative investigation into performance on retrieval and inference questions
These analyses are based on the coding framework, which categorises frequent correct and incorrect answers to questions in an attempt to analyse any patterns that may emerge relating to TA reading ability level and/or condition (control versus stress). Frequency distributions by condition were produced for each of the questions that had been further coded to account for the range of answers given. It should be noted that answers may be coded in more than one category on a given question, therefore percentages across coding categories will not necessarily add up to 100%.

1/ Retrieval questions
A/ Non-essential retrieval
Questions 1, 2, 5 and 7 can be grouped together as straightforward memory questions for 'trivial' detail, which are not essential to an understanding of the text. Differential patterns of performance on these questions suggests that they can be further sub-classified: questions 1 and 5 relate to retrieving a name, whereas questions 2 and 7 relate to retrieving a number. Frequencies of correct responses to both questions 1 and 5 were extremely low (4.5% and 1.5% respectively), with very high omission rates. There was no effect of condition on these questions. These details are not perceived to be important details to remember, as these questions are not 'typical' comprehension questions. It would be interesting to investigate whether the results would have differed in a recall task in which participants are asked to recall all that they can remember in as much detail as possible.

A different pattern emerges with questions 2 and 7. Over 40% of all participants correctly answer these questions, accompanied by much lower omission rates. It may be that, although not essential to the comprehension of this text, these numerical details are more salient than are the names of the hotel and shop in the story. There appears to be an effect of condition, with the majority of those participants in the control condition answering these questions correctly. In the stress condition, those at levels 4 and 5 are more likely to answer this question correctly than are those at level 3.

B/ Essential retrieval
Questions 3 and 8 are retrieval questions that have relevance to global comprehension of the story. Both of these questions were rated low on item difficulty in the Rasch analysis, with high percentages of the overall sample answering these questions correctly (86.4% and 94.0% respectively). It is clear that there is a level effect, with more participants at levels 4 and 5 exhibiting more evidence of retrieval. There does not appear to be an effect of condition on responses to this question.

C/ Retrieval prone to interference
For questions 12 and 17, incorrect responses may be due to confusion with other details given in the text. Furthermore, question 17 is also prone to errors if the general point of the story has been misunderstood and participants have misinterpreted the story, having been unable to

draw the correct inferences, and incorrectly thinking that Mr. Rudge had actually stolen the necklace. On question 12, there does not appear to be an effect of stress, with participants in the control condition tending to give a relatively more specific answer, compared to participants in the stress condition. An analysis of incorrect answers suggests that stress is more likely to affect participants at levels 3 and 4. This may be because, in a time-induced stress condition, readers may be more prone to interference effects. This is supported by a similar analysis of wrong answers to question 17; the majority of wrong answers have been coded as 'in her drawer', as opposed to in Mr. Rudge's room (a misunderstanding of the story). Of those who wrongly give the answer of 'Mr. Rudge's room', the majority are level 3 participants. There appears to be no effect of condition.

2/ Inference questions
A/ Simple 'backward' inferences based on commonly-held schemas
Questions 4, 6 and 13 are simple 'backward' inferences, in which participants must integrate text-based and knowledge-based information. Questions 6 and 13, in particular, are likely to draw on commonly-held schemas: a 'where jewellery is bought' schema, and a 'calling the police' schema respectively. Even Year 6 children are likely to hold schemas relating to these types of events.

On question 6, 87.9% of participants answered this question correctly. Interestingly, no level 3 participant answered this question incorrectly. For those participants at levels 4 and 5, it may be that they were attempting to draw a more complicated inference, drawing to a greater extent from information given in the text. It would appear that these participants have attempted to incorporate information given in the text, for example, "..in the sale", "..absolute bargains" "..closing down sale". This is probably because they are familiar with comprehension tests that typically require them to do this, as opposed to merely requiring them to draw a simple knowledge-based inference.

Question 13 ('Why did Mrs. Channing want to call the police?') was ranked as the easiest question on the test, with 95.5% of the participants answering it correctly. A qualitative analysis of answers given shows that 93.7% of correct answers consisted of a statement along the lines of 'because she thinks the necklace has been stolen'. The second most common right answer (19.0%) was a statement referring to the value of the item.

B/ Necessary 'backward' inferences
Question 9 requires the participant to integrate the information of 'not putting off first timers' with information given earlier in the text about the hotel's high reputation. Participants' knowledge and experience of hotels (a 'hotel' schema) would help them to make sense of this, and draw a correct inference. What distinguishes this question from questions 4, 6 and 13 in the preceding section relates to the dimension of 'necessity'. Understanding the importance and relevance of the reputation of the hotel is central to an understanding of the motivation behind a number of Mrs. Mason's thoughts and actions, and thus correctly answering a number of subsequent questions. 57.8% of participants answered this question correctly. A qualitative analysis of responses shows that 60.5% and 55.3% refer to Mr. Rudge being a 'first timer', or that Mrs. Mason wants 'first timers' to return respectively in their answers. Just over a quarter of correct answers (26.3%) refer to Mrs. Mason's concern with the hotel's reputation. This more sophisticated inference was made to a greater extent by level 4 and level 5 participants. There appears to be no effect of condition. However, the numbers of participants making this specific inference are very small (n= 10), and as a consequence, this

makes it difficult to draw any firm conclusions. With regards to incorrect answers, these are more likely to occur in the stress conditions.

Question 10 builds on question 9, requiring an understanding of the importance of the hotel's reputation. Only just over one third (34.8%) answered this question correctly, with 56.5% of these participants making a direct reference to the hotel's reputation. There is an effect of level, with the majority of participants giving this answer being level 5 participants, and with more participants at level 3 answering incorrectly. There is also a suggestion that time-induced stress may have an effect, particularly at levels 4 and 5. A small proportion (15.2%) misinterpreted the question, interpreting it instead to be asking about Mrs. Channing's feelings, rather than Mrs. Mason's feelings. These participants (across all three levels) were all in the stress conditions. It is unclear that there is any relationship between condition and this incorrect answer, given that the problem appears to be a misinterpretation of the question given after the delivery of the text presentation.

On question 14, participants must be able to distinguish between what Mrs. Mason initially says to Mrs. Channing, and what Mrs. Mason actually thinks. Over two thirds (68.2%) of the participants answered this question correctly, with 44.4% of these participants giving a specific reference to Mr. Rudge, and the other 55.6% making the more general inference that she thinks it has been stolen. There does not appear to be an effect of level. Incorrect answers corresponded to Mrs. Mason's verbal suggestions to Mrs. Channing (that is might have been mislaid, or that it slipped off outside). Although numbers are small, the results suggest that there may be an effect of condition, with incorrect answers more likely to be made by participants in the stress condition.

Over half of all the participants (54.5%) answered question 15 correctly. This question shows a clear effect of level, particularly between levels 4 and 5. The most common wrong answer was not merely a direct retrieval of the word 'guest'; interestingly only one level 3 participant (in the control condition) gave this as a response. Rather, participants suggested that Mrs. Mason searched Mrs. Channing's room. Again, there is a level effect, with increasingly fewer incorrect answers with a concomitant increase in level.

C/ Inferences relating to the emotions of characters in the text
The final question of the test requires a backward inference that illustrates whether participants have understood the central components of the story: that, in fact, there are two necklaces, with Mr. Rudge having bought one himself. It also requires an understanding of Mrs. Mason's emotional reactions as a consequence of the series of events in the story. 48.5% of participants answered this question correctly, with half of these providing an elaboration specifically explaining that Mr. Rudge had his own necklace, and that Mrs. Mason had misread the situation. The other half referred to the emotional reactions, in terms of Mrs. Mason feeling relieved. A minority (n = 3) mentioned that Mrs. Mason may have felt guilty or stressed (n = 2) by the situation. Very few level 3 participants referred to the emotional reactions, regardless of condition. A relatively large number of participants (21.2%) incorrectly inferred that Mrs. Mason was 'tired'. The majority of these tended to level 3 participants, regardless of condition.

Making inferences about the emotions of characters was also a feature of question 16. Almost half of all participants (47.0%) answered this question correctly, with almost two thirds (61.3%) of these participants explaining that Mrs. Mason had just come from his room. This confirms that they understood that he was the guest whose room she had just searched (the

answer to the previous question), but it does not explicitly make a comment explaining her feelings. About one quarter of all participants answer that she is shocked because she thinks that he is a thief, the majority of these being level 5 participants. However, in terms of referring specifically to how she feels, only six participants suggest that she feels guilty or that she is scared of him. Only one of these participants is a level 3 participant. These findings suggests that there may be an effect of level, with participants at higher levels being more likely to make an inference regarding the feelings of characters in stories. There does not appear to be an effect of condition.

Conclusions

The central question of this study was to investigate the effects of time-induced stress on children making inferences during text comprehension. Previous research findings have suggested that readers who have difficulty comprehending a text may also have difficulty making inferences (Oakhill, 1984), and this has been related to constraints in working memory (Yuill & Oakhill, 1991). In addition, it has been shown that successful comprehension depends on integrating knowledge-based, as well as text-based information in order to make inferences (Colley, 1987; Spires & Donley, 1998). It was hypothesised that time-induced stress would have a detrimental effect on the ability to make inferences during a text comprehension task, and this effect may be explained in terms of limited working memory processing capacity. More specifically, under conditions of time-induced stress, comprehension performance may suffer as a result of decreased ability to maintain relevant information and/or decreased ability to suppress irrelevant information (Engle & Conway, 1998). This hypothesised effect of time-induced stress on making inferences is based on research findings that illustrate reduced performance on a range of cognitive tasks under conditions of stress (Brown & Markman, 1991; Dyson & Haselgrove, 2000; Masson, 1985; Tolhill & Holyoak, 2000). In addition, we attempted to investigate whether time-induced stress has a differential effect on children of different TA reading ability levels.

Working memory
The results from this study show that an increase in TA reading ability level is accompanied with an increased working memory capacity, as measured by the two working memory measures. In addition, at least for the verbal working memory measure, there was a significant correlation between this measure and total score on the comprehension test. This provides support for the theoretical position that working memory plays an important role in reading comprehension. Yet correlations between working memory and inference questions are not significant, nor are they greater than correlations between working memory and retrieval questions. This does not support previous research findings that show a significant correlation between working memory and inference questions. It is unclear how to interpret these findings. It may, in part, be explained by the fact that the working memory scores were not normally distributed in this sample, with the majority of participants scoring in the mid-range. In addition, the numerical working memory measure did not correlate with total score on the comprehension test. This does not replicate earlier findings (Yuill et al., 1989) of a correlation between a numerical working memory measure and reading comprehension, which had been interpreted in terms of processing during text comprehension representing a general processing capacity rather than a specific verbal processing capacity. The findings of this study instead suggest that processing that occurs during text comprehension reflects a more specific verbal capacity. It would be of interest to attempt a replication of this finding in future research.

Overall level and gender differences
The results of the item bias analyses and also analyses of variance investigating gender and level effects are reassuring at least in terms of test construction. These results show that, in the case of gender differences, there are no statistically significant differences in performance between boys and girls either on the test as a whole, on the sub-components of inference and retrieval questions, or even on a question by question basis. With respect to level differences, it was expected that text comprehension performance would increase with an increase in level. The findings from this study support this, both in terms of total test score on the comprehension test, and separately on the sub-components of inference and retrieval. In this study, it can be seen that there are greater improvements in making inferences between levels 3 and 4, compared to retrieval of information. Previous studies (QCA, 1998; QCA, 1999) have shown that there are significant improvements in children's abilities to make inferences as they move from level 3 to level 4.

Effects of stress on text comprehension
A/ Emotions
Results from this study suggest that children of this age have specific difficulties making inferences relating to emotions, and that is especially marked in those participants level 3. This occurs regardless of condition: participants found it equally difficult to draw inferences relating to emotions even in the control (non-stress) condition. This also supports findings from the pilot study that illustrated participants' difficulties understanding complex emotional reactions of characters. It may be that inferences that involve complex emotions may not be made on-line in participants of this age. Although such inferences contribute to an overall coherent representation of the story, and may be made automatically in adults, this may not be the case in children for developmental reasons.

Questions 9 and 10, and also questions 14, 15, 16 and 18 draw upon a 'hotel reputation' schema, which also ties in with the emotional reactions of the characters in the text. There is some qualitative evidence to suggest that there may be a time-induced stress effect. The participants that answered incorrectly on some of these questions were more likely to be in a stress condition. However, the numbers in the control condition are low, making this finding inconclusive.

B/ Schemas
It may be that under conditions of stress, which increase processing constraints, readers may be more likely to rely on commonly-held schemas. This may be the case in question 18, in which some participants explained Mrs. Mason's collapsing into her chair in terms of her 'being tired' or 'having a leg problem'. However, the majority of these participants tended to be level 3 participants, with level 3 participants in the control condition also tending to make this error, which suggests that this may be confounded with cognitive development – it may just be a level effect. Indeed, question 16, which draws on an understanding of emotions shows a clear level effect but no condition effect. It would be particularly interesting to attempt to disentangle these level and condition effects. This issue could be further investigated by collecting additional numbers of participants at each TA reading ability level in the control group. In addition, a range of schemas of varying complexity could be used specifically to research the question of the effects of time-induced stress on making inferences related to more commonly-held and less commonly-held schemas in children of this age.

Another schema that participants drew upon was a schema relating to what typically happens when a valuable item is thought to have been stolen. Almost all participants answered the question relating to this schema correctly. In fact, participants could have inferred the correct response to this question based entirely on their prior knowledge and experience, rather than deriving it from information in the text. This 'calling the police' schema being utilised in this story is a stereotypical one, and hence is unlikely to cause participants unnecessary difficulty. Indeed, this is what was found to be the case. This is unlike in the initial pilot study, where certain non-stereotypical situations occurred. In such a context, it was found that text comprehension was more likely be distorted in order to conform to readers' schematic information. From a test construction perspective, question 13 clearly does not discriminate well between the levels. Yet for the purposes of this study, this question shows that participants at all levels were able to draw upon commonly-held schemas in order to comprehend aspects of a text. Given that almost all participants answered this question correctly, it suggests that there are no adverse effects of time-induced stress on this process. However, this ceiling effect makes it is difficult to interpret the effects of time-induced stress on this process. It would be more illuminating to investigate the effects of time-induced stress on making inferences based on schemas, when the schema does not necessarily conform to what is in the text, or is less straightforward.

Implications for future research
In an educational climate of increasing national assessment, the question of the effects of stress on examination performance is one of growing relevance. There are a number of studies that have investigated the effects of stress on various aspects of cognitive performance, but relatively few have conceptualised stress in terms of time. There has been one study conducted recently (Dyson & Haselgrove, 2000) which investigated the effect of reading speed on 'higher order' skills in text comprehension in adults. In our study, we have also investigated the effect of speed (or stress) on making inferences, but the participants involved in this study were Year 6 children.

Our study was also conducted on the computer, and in addition, we obtained working memory measures in an attempt to elucidate the relationship between stress and text comprehension within the theoretical framework of working memory processing constraints. Interesting avenues for future research could further investigate text comprehension processes on the computer as the computer is likely to be increasingly used as a mode of assessment in education. It will also become of increasing political importance to investigate the effects of stress on different aspects of cognitive performance in children, and to attempt to account theoretically for these effects within a working memory framework.

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Appendix

Procedure Instructions:

"Now you're going to read a story on the computer. When we start, you will see the title of the story, which I will read out to you. This is followed by the introduction, which I will also read out to you. Then the story will start (For the control condition: "When you are ready to start, click on the mouse, and the story will start. When you have finished reading what is on the screen, click on the mouse to go on to the next screen. Keep doing this until you reach the end of the story."). We will do a practice story first, so that you get the hang of it. When the story starts, you have to read what is on the screen before the next screen comes on. There is a black bar at the bottom of the screen that gradually turns white. When it turns all white, this means that your reading time is finished, and the next screen will come on. You will have to read quite quickly, but you should still try and understand what you are reading, as I will ask you about the story afterwards."

The Text

"The Emerald Necklace" (extract from 'English Alive', Teacher's Resource Level 5, Collins Educational (1995).

The Fairbank Hotel at Sandy Bay hardly ever needed to advertise. Most of the time it was fully booked with satisfied guests, many of whom returned again and again. Mrs. Mason had worked hard for twenty years building up the hotel's high reputation.

One morning she was serving breakfast when Mrs. Channing, a regular guest, stopped her. 'Mrs. Mason, just look what Steve bought me yesterday.' She was wearing a most splendid emerald necklace. Privately, Mrs. Mason thought it was far too flashy for breakfast, but she said,
'Why it's beautiful, Mrs. Channing! How kind of Mr. Channing.'
'It's not as expensive as it looks,' said Mr. Channing.
'But still expensive,' pointed out his wife.
'It was in the sale at Carruthers on the high street. He had three of them. Absolute bargains, really. Closing down sale apparently.'

Mrs. Mason moved on to the next table. She was quite envious of Mrs. Channing. Secretly, she felt the necklace would suit her much better. 'It would match my eyes,' she said to herself. The guest she was serving looked up at her.
'Did you say something?' he asked. Mrs. Mason flushed.
'I'm sorry, Mr. Rudge,' she smiled, 'I was talking to myself'. She moved on wondering what Mr. Rudge must think of her. He was a new guest, what she referred to as a "first timer".
'Mustn't put off first timers,' she thought.

That afternoon, Mrs. Channing came bursting into her little office.
'Mrs. Mason, a dreadful thing has happened! My emerald necklace has gone!'
Mrs. Mason's heart sank.
'Have you mislaid it in the hotel?' she asked.
'No, Mrs. Mason, I'm sure I haven't!'

Mrs. Mason tried to calm Mrs. Channing. 'Perhaps your necklace had a faulty catch, and slipped off? Maybe outside the hotel?'
'No, Mr. Channing advised me not to wear it outside. I left it in a drawer in our room. I think we should call the police.'
'Why don't you have one last look first?' suggested Mrs. Mason.

As the Channings went off muttering, a terrible thought took shape in her mind. She began to think about Mr. Rudge. He had seen Mrs. Channing showing off her necklace. Her regular guests were above suspicion, but Mr. Rudge was a first timer, a stranger. All she knew about him was that he came from Peterborough and was booked in for two nights. He had gone out after breakfast, returned for lunch, and was now out again.
Mrs. Mason then did a thing she had never done before. She ran upstairs and began to search a guest's room. At the bottom of a drawer, she found the emerald necklace. She removed it and set off down the corridor to the Channing's room. As she turned a corner hear the top of the stairs, she almost bumped into a returning Mr. Rudge.

'Oh I do beg your pardon, Mrs. Mason,' he said, but she was too shocked to speak. He went down the corridor and entered his room.

The Channings' room was empty. Mrs. Mason hurried down to her office.

'We've found it, Mrs. Mason,' an overjoyed Mrs. Channing greeted her. 'It was in my handbag all the time!'

Mrs. Mason collapsed into her chair.

Questions

1. What is the name of the hotel in the story? (R)
2. How many years had Mrs. Mason been working at the hotel? (R)
3. What sort of reputation did the hotel have? (R)
4. Who bought the necklace for Mrs. Channing? (I)
5. What was the name of the shop where Mr. Channing bought the gift? (R)
6. What type of shop was *Carruthers*? (I)
7. How many necklaces were there in the shop? (R)
8. What did Mrs. Mason think of the necklace? (R)
9. Why did Mrs. Mason want to make a good impression on Mr. Rudge? (I)
10. Why did Mrs. Mason's heart sink when Mrs. Channing told her that her necklace had gone? (I)
11. Did Mrs. Channing wear her necklace outside? (I)
12. Where did Mrs. Channing think she had left her necklace? (R)
13. Why did Mrs. Channing want to call the police? (I)
14. What does Mrs. Mason think has happened to the necklace? (I)
15. Whose room did Mrs. Mason search? (I)
16. Why was Mrs. Mason shocked when she met Mr. Rudge in the corridor? (I)
17. Where did Mrs. Channing find her necklace? (R)
18. Why does Mrs. Mason collapse into her chair at the end of the story? (I)

Key: R = Retrieval-based question
            I = Inference-based question

Working Memory Tasks

a) Lists of three-digit numbers (2, 3, 4 and 5) that will be presented one at a time on the computer screen that children will read out aloud, and then be asked to recall the last digit of each set: e.g. 437 – 982 Answer: 7 2.
b) Lists of unrelated sentences (9-13 word sentences) – again 2, 3, 4 and 5 presented on the computer screen that children will read aloud, and then be asked to recall the last word of each sentence.
(I have given two eg.s of each)

a)
Example: 358 - 702

  427 – 983   514 – 280
  681 – 397 – 924   145-708-326
  758 – 241- 693 – 027   915 - 628 – 312 – 574
  105 – 723 – 460 – 859 –274   093 – 715 – 439 – 628 - 942

b)
Example: He opened the garden gate and walked up the path.
**   She was tired because she had been travelling all day.**

Sam and Clare looked at the row of bikes in the shop.
Joanne got up late and found her mother doing the cleaning.

The thin, black cat jumped up onto the fence.
She read her book in the armchair by the fire.

They always did everything together because they were twins.
On the way home, he stopped at the corner shop.
The shepherd herded the lambs into a pen nearby.

As he dived into the water, it felt very cold.
She listened to the radio while she did the ironing.
Sally put on her coat and scarf before going outside.

When the bell rang, the children hurried back inside.
Steve and his mother lived in a small two-bedroomed house.
Robert had accidentally kicked the ball through the window.
The night was clear and crisp and the moon was high.

Chris was looking forward to going away on holiday.
The house was at the end of the dimly-lit street.
Tom went to the park to play football with his friends.
Because of the bad weather, the plane was delayed.

The black and white photograph was torn at the edges.
After reaching the top of the hill, Emma was completely out of breath.
Hearing a sound behind him, he turned round quickly.
She caught a bus into town and met up with her friends.
Sarah could not believe what John had told her.

She had always wanted to go travelling around Europe.
The bookshelves were stacked high with all sorts of books.
Although he was afraid of the water, Andrew decided to have swimming lessons.
They went out for dinner at an Italian restaurant.
When she got to the shop, it was already closed.

Transcriptions of Reading Test

Barrington School – Hollie Taylor female TA 5.8 Condition click

Number sets	Last numbers
358 702	8 2
427 983	7 3
514 280	4 0
681 397 <u>294</u>	7 4 1
145 708 326	5 8 6
758 241 693 027	7 3 8 1
915 628 312 574	4 2 uh uh 3 2 7?
105 723 460 859 274	4 8 0 5 3
093 715 439 628 942	2 8 3 5 uh, can't rememberh
Sentence sets	**Last words**
	shop cleaning
	fence fire
	twins shop nearby
	cold ironing outside
	inside house high
	holiday street plane delayed
	edges quickly friends can't remember
	Europe book path restaurant closed

Questions	Answers
1	Um, don't think I can remember that
2	20
3	A good one
4	Mr Channing
5	I don't know, I thought it was the Emerald Shop but don't think it was that
6	Jewellery shop?
7	3
8	She *loved* it. She wanted it. She thought it shouldn't be dazzling around at breakfast
9	Because he was a new...a first timer as she called him. She didn't want to like make him think it was a bad hotel
10	'Cos she thought they might get a bad reputation from losing the necklace and they might think somebody had stolen it from the hotel
11	Yeah...I don't know...I'll go for no.....um.....yes
12	Outside. On the table
13	'Cos she was worried about her necklace
14	Been stolen
15	Mr Rudge's
16	'Cos she thought he'd stolen the necklace. Um. She thought that a robber was in her hotel
17	Um, dunno

18	'Cos she's relieved that Mr Rudge didn't actually steal the necklac and she felt a bit guilty 'cos it might have belonged to Mr Rudge

The Emerald Necklace - Coding Framework
Question:

1/   *./0/1*

2/   *./0/1*

3/   *./0/1*
  good   reputation is good
  more   further descriptive comment e.g. no need to advertise, etc

4/   *./0/1*

5/   *./0/1*

6/   *./0/1*

7/   *./0/1*

8/   *./0/1*
  like   likes the necklace or similar
  desc   description of the necklace, e.g. beautiful, expensive etc
  breakfast   mention relating to inappropriate for breakfast
  eyes   would match her eyes
  better   would suit her better
  envious Mrs. Mason envious of Mrs. Channing

9/   *./0/1*
  first   Mr. Rudge is a 'first-timer' or similar
  again   Mrs. Mason wanted him to come again
  rep   concern with reputation of hotel
  necklace   Mrs. Mason wants Mr. Rudge to get her a necklace (X)
  stolen   Mrs. Mason thinks he has stolen the necklace (X)

10/   *./0/1*
  rep   concern for the reputation of hotel
  Channing   concern for Mrs. Channing
  stolen   she thinks it has been stolen
  like   likes the necklace (X)
  misund   misunderstanding of subject of question (X)

11/   *./0/1*
12/   *./0/1*
  drawer   in her drawer
  room   in her room
  hotel   in the hotel somewhere (X)
  outside   outside somewhere (X)

handbag   in her handbag (X)

13/   ./0/1
  stolen   because she thinks it's been stolen
  expensive   because it's expensive/valuable
*worried*because she's worried
  like   because she likes it
  want   because she wants it back
  lost   because the necklace is lost (X)
  Rudge   Because she thinks Mr. Rudge has stolen it

14/   ./0/1
  Rudge   Mr. Rudge has stolen it
  stolen   it's been stolen
  mislaid   it's been mislaid (X)
  slip   slipped off outside (X)

15/   ./0/1
  Rudge   Rudge's room
  Channing   Channing's room (X)
  guest   a guest's room (X)

16/   ./0/1
  thief   she thinks he's a thief
  hisroom   she's just been in his room
  sudden   it's a shock to suddenly see him
  guilty   she feels guilty for having been in his room
  scared   she's scared of him

17/   ./0/1
  handbag   in her handbag
  Rudge   in Rudge's room (X)
  drawer   in her drawer (X)

18/   ./0/1
  relief   relief that situation's been resolved
  guilt   guilt relating to Mr. Rudge
*stressed*stressed regarding the situation
  Rudgemis   explanation of misunderstanding relating to Rudge
  tired   she's tired/exhausted/physical reason (X)