

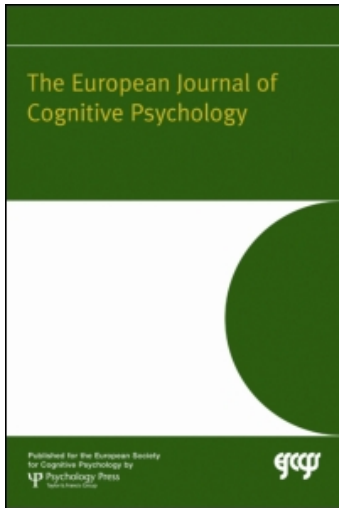
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### Of sports and politics: Predicting category-specific retention of news events from demographic variables

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## Of sports and politics: Predicting category-specific retention of news events from demographic variables

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Many tests of retrograde amnesia consist of questions on news events. It is therefore important to know how such questions are answered by normal adults. We analysed the retention of news events in a sample of 12,913 participants, who provided basic demographic information and subsequently answered questions about news events randomly sampled from a database. We investigated whether demographic variables could predict differences in the intake and retention of news from several categories, such as sports and business news. Although demographic variables did affect general performance on news questions, differential effects on specific categories were marginal. Gender influenced performance on questions about business news, both age and educational attainment affected performance on political news, and educational attainment also had an effect on performance on science news.

**Keywords:** Episodic memory; Forgetting; Public events; Retrograde amnesia.

Retrograde amnesia is a form of memory loss defined as being unable to recall events that occurred before the onset of amnesia (as opposed to anterograde amnesia, where new events are not stored in memory). It is a feature of Korsakoff's disease and Alzheimer's disease (e.g., Kopelman, 1989) and of discrete lesions to the medial temporal lobe (e.g., Reed & Squire, 1998), to the thalamus (Hodges, 1995), or to the basal forebrain (Gade & Mortenson, 1990).

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Because some loss of memories is to be expected because of forgetting, it is difficult to test for retrograde amnesia. Usually patients are not tested before the onset of retrograde amnesia, so the amnesia must be tested by comparing remote memory of a patient to that of a normal person. Two kinds of remote memory tests exist for this purpose, but neither is without its problems. The first consists of tests of autobiographical memories (e.g., Kopelman, 1994; Piolino et al., 2003). In these tests participants are given questions about for example names of relatives or of attended schools, or are asked to recount anecdotes from certain life time periods (e.g., early adulthood). These tests have the drawback that the memories reported by patients cannot easily be checked for accuracy, making it difficult to distinguish intact memories from confabulations.

The second category consists of tests that query knowledge of public events (Leplow & Dierks, 1997; Mayes et al., 1994; Meeter, Eijssackers, & Mulder, 2006; Sanders & Warrington, 1971; Squire & Slater, 1975). These tests contain questions about news stories for which the accuracy of the answers can be established easily. The underlying logic is that if the selected events are familiar to all or most people within a culture, then not being able to answer the questions is indicative of memory loss. Unfortunately, few such events exist, and in practice scores on such tests are strongly influenced by general knowledge (Klumps, 2001), educational attainment (Howes & Katz, 1988; Meeter, Murre, & Janssen, 2005), and IQ (Howes & Katz, 1988; Kapur, Thompson, Karsounis, & Abbott, 1998; Kopelman, 1989). The strongest predictor of scores is, however, media consumption (Kapur et al., 1998; Meeter et al., 2005). This suggests that knowledge of public events is strongly determined by one simple variable, namely how interested the patient is in the news. This in turn suggests that if such interest can be predicted from demographic variables, one could correct for absence of interest and uncover failures of memory more efficiently. We therefore studied whether demographic variables are correlated with retrieval of public events.

Two demographic variables that have been studied in this context are gender and age (Howes & Katz, 1988; Meeter et al., 2005; Rubin, Schulkind, & Rahhal, 1999; Storandt, Grant, & Gordon, 1978). Studies generally yield small benefits for men over women, and for younger over older adults. Older adults do better on news from distant periods that only they lived through, whereas younger adults tend to outperform them on news from recent periods in which all were adults. This could plausibly be due to differences in acquisition rate, as older adults also perform worse than younger adults when tested on news events studied in the laboratory (Frieske & Park, 1999). Such an explanation is unlikely to account for the effect of gender, not only because there are no gender differences in retention of autobiographical memories (Rubin et al., 1999), but also because the advantage of men over women tends to be specific for categories of news. Howes and Katz (1988)

found that men outperformed women on questions from their politics/disasters and sports/crime categories, but not on the people/entertainment category. Similar findings were reported by Storandt et al. (1978) and by Rubin et al. (1999). This suggests that news categories could be important mediators for the effects of demographic variables on news retention.

Here, we therefore investigated whether there are interactions between demographic variables and with retrieval of news events from certain news categories. We analysed data from the Daily News Memory Test (DNMT; see [www.memory.uva.nl/testpanel](http://www.memory.uva.nl/testpanel)), which is an online test containing open-ended and multiple-choice questions about recent news events. By presenting the test on the Internet, we were able to test a very large group of participants with a diverse demographic background. It also gave us the opportunity to enter questions about news event at the moment they occurred and to track them until they were several years old.

Data from the DNMT was also used in Meeter et al. (2005) in their Experiment 1, but since the test is still operative, we will use a larger sample in this study. Meeter et al. established that performance on the news questions was higher for older, male and higher educated participants, and for participants that read newspapers and viewed news programmes frequently. To maximise the likelihood of finding differential patterns of performance on categories, we looked at *relative performance*: after correcting for overall performance level.

## METHOD

### Participants

Data analysed in this study was collected with the DNMT. The test has two versions, a Dutch and an English one, but we only analysed the results of the Dutch version because of the difficulty in comparing educational attainment across countries. The test was published online on November 2000 and is still collecting data. For this experiment, we used the results from all tests completed until July 2006.

The participants could come into contact with the website in several ways. First, related research websites linked to the website. Second, the site was indexed by many search engines, and participants were often guided towards the site with memory-related searches. Third, some magazines and newspapers published items in which the address of the website was given. Fourth, participants were provided at the end of the test with the option to invite friends, family and colleagues to take the test. Finally, participants who had taken other tests on the website, such as the Galton-Crovitz test (Janssen, Chessa, & Murre, 2005), were invited to take the DNMT as well.

At their first visit, participants were asked to fill out a registration form with background questions on age, gender, news consumption, and education level. Usernames and passwords were chosen by the participants in order to allow them to take another questionnaire without reentering their registration information, which helped us identifying participants who took the test more than once. Results from 12,913 participants, who had completed a total of 22,550 sessions ( $M = 1.75$  sessions per participant), were analysed in this study. The group consisted of 5929 male and 6984 female participants. The average age of the participants was 40.72 years ( $SD = 14.85$ ), the majority had a university or an equivalent degree (58.1%), and about half read the newspaper on a daily basis (45.2%).

## Materials

The questions were constructed by the third author (SJ). Each week he compared the content of national newspapers to items in news programmes on television. When an item had appeared on the front pages of the newspapers and had been presented on the news, it was transformed into a question by substituting a role in the headline (person, place, activity, outcome) by an interrogative clause (who, what, where).

Before inclusion in the database, questions were checked to make sure their answer could not be deduced from unrelated news items. Questions were prepared in open-ended and multiple-choice format. In the prior format, participants were asked to write the answer in an open text field, whereas they had to choose one of four alternatives in the multiple-choice format. Scoring of the answers to the open-ended questions occurred automatically by comparing the participant's answer with a word or a part of a word indicative of the correct answer. If performance on a particular question in multiple-choice format was at chance level after either 30 or 60 days, the question was deemed too difficult and removed from the database. In all, 1603 questions were retained.

We made some changes to the test during the course of the experiment. At the beginning of the study, sessions consisted of 40 multiple-choice questions, but sessions were changed in June 2001 to include 10 open-ended and 20 multiple-choice questions. The questions were selected on the basis of the time between the news event and the test. They were sampled from the database with a likelihood of 30% that the news event had occurred within the most recent 30 days, another 30% likelihood that the event had happened in the period of 30–60 days before the test, and a likelihood of 40% that the event that had taken place in the period of 60 to 365 days before the test. In February 2003, these three percentages were changed into 25%, 25% and

30%. The remaining questions occurred between either 17 and 18 months ago or 23 and 24 months ago (both with a likelihood of 10%).

The questions were divided into nine categories (domestic, foreign, business, sports, entertainment-royalty, crime, disasters, politics, and science-technique). Categories played no role in creating new questions or in sampling questions. Some categories therefore contain more questions than others. We have given the number of questions and responses for each news category in Table 1, alongside an example of a question from each category.

## RESULTS

The data set consisted of a grand total of 659,837 trials. Because the number of questions per category varied and could be quite low in some test sessions, average scores would not yield a metric fit for linear regression. We therefore decided to use a binary logistic regression, which allows for the prediction of the binary outcome of individual trials based on both continuous and discrete predictors. As predictors we used gender, age, level of education, and newspaper consumption. Three more predictors were used in the analyses, essentially as covariates: the format of the question (multiple-choice vs. open), the age of the question (entered to address effects of forgetting), and the proportion of remaining questions in the session answered correctly.

Predictors were entered in stepwise fashion. Because of the very large data set, even minute effects of predictors are significant by any given criterion. We therefore entered predictors not on the basis of significance, but on the basis of the increase in explained variance. An increase, with entry of the predictor, in Nagelkerke's (1991) maxed-rescaled generalised  $R^2$  of at least .005 was taken as the criterion.<sup>1</sup> All results are summarised by news category in Table 2.

### Overall performance

Table 3 shows the outcomes of logistic regression on the likelihood of answering a question correctly. Weights are given for predictors that were entered in the regression analysis. For each predictor, three indicators are

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<sup>1</sup> This criterion is as arbitrary as the conventional threshold on  $p$ -values of .05. We also contemplated criteria on other measures, most notably on the percentage of trials classified correctly with help of the regression line. A criterion of an increase in this percentage of at least 1% led to virtually the same results as those using our criterion on  $R^2$ . Both criteria separate predictors with a large, medium, or small effect from those with an extremely small, but in our dataset nevertheless significant, effect.

TABLE 1  
The number of questions and trials, and an example of a question, in each news category

<i>Category</i>	<i>Questions (N)</i>	<i>Trials (N)</i>	<i>Example</i>
Domestic news	268	53,318	In front of which supermarket did homeless person Anja Joos die on October 6, 2003 after personnel had beaten her up?—Dirk van den Broek
Foreign news	436	88,541	What was the name of the Serbian president who was assassinated on March 12, 2003?—Zoran Djindjic
Business	99	20,936	What was the name of the Italian bank that ABN AMRO wanted to take over on March 31, 2005?—Banco Antoveneta
Entertainment	255	60,103	For which Broadway production did Joop van den Ende receive two Tony Awards in New York City on June 3, 2001?—42nd Street
Crime	83	19,441	What was the name of the French serial killer, who admitted on July 3, 2004 to murdering nine girls?—Michel Fourniret
Politics	136	33,820	Which party leader resigned after his party lost the local elections of March 7, 2006?—Jozias van Aartsen
Disasters	128	27,877	Off the coast of which African country did the ferry Le Joola sink on September 26, 2002, killing more than 1800 people?—Gambia
Sports	132	28,462	For which football team did David di Tommaso play, who died on November 29, 2005 at the age of 26 from a heart attack?—FC Utrecht
Science	66	10,417	What was the name of the space probe that entered the orbit around Saturn on July 1, 2004?—Cassini-Huygens

given: the raw regression coefficient ( $B$ ), Wald's statistic, and the exponential of  $B$  ( $e^B$ ). Wald's statistic was used for significance testing; higher values denote larger deviations from the null hypothesis of no effect. All values in the table lead to rejection of the null hypothesis. The regression coefficient, either raw or as exponential, is a measure of effect size.  $B$  gives the influence of the predictor on the logarithm of the odds of a correct response. The

TABLE 2  
 For each news category, the percentage of correct trials, Nagelkerke's  $R^2$ , percentage of correctly predicted trials, and the odds ratios within the same category and compared to different categories

Category	Percentage correct	Nagelkerke's $R^2$ retained model	Correctly predicted trials	Odds ratio	
				Same category	Different category
Domestic news	62.8%	.174 (.178)	66.8%	1.09	1.11
Foreign news	53.1%	.157 (.162)	64.2%	1.14	1.10
Business	59.7%	.147 (.154)	65.6%	1.19	1.12
Entertainment	58.5%	.152 (.158)	65.3%	1.09	1.09
Crime	63.0%	.195 (.197)	69.2%	1.02	1.08
Politics	64.2%	.217 (.221)	68.9%	1.21	1.13
Disasters	52.2%	.133 (.134)	63.0%	1.07	1.08
Sports	53.0%	.136 (.142)	63.6%	1.18	1.09
Science	56.8%	.150 (.151)	63.7%	1.04	1.07

exponential of  $B$  (last column in Table 3) is easier to use, as it can be interpreted in terms of odds instead of in the logarithm of odds. For each unit increase of the predictor, the odds of a correct response become larger or smaller by a factor  $e^B$ . An  $e^B$  close to 1 indicates small effects (i.e., varying the predictor changes little in the odds of a correct response). A large  $e^B$  indicates a large effect, in that the odds of a correct response is much higher for large than for small values of the predictor. An  $e^B$  close to 0 indicates an opposite large effect, with low odds of a correct response for large values of the predictor. As an example, in the first analysis in Table 3,  $e^B$  is 0.3 for question format and 1.11 for education. This means that when the format changes from multiple choice (0) to open (1), the odds of a correct response become more than three times smaller, while increasing education from one level to the next increases the odds of a correct response with 11%. As the example shows, the size of the effect of a predictor depends not only on the value of  $e^B$ , but also on its range. Several predictors (session mean, question format, gender) range between 0 and 1, education and newspaper consumption from 1 to 7, age from 12 to 82, but question age ranges between 0 and 730 (days). The effect of question age is thus deceptively small when judged by  $e^B$ .

We first looked at the performance on all trials. As shown in the first rows of Table 3, the likelihood of answering a question correctly was determined by characteristics of both the question and the participant. The format of question (multiple choice vs. open ended) had the largest effect, with a smaller effect for the age of the question. Participant characteristics that had large effects were education and newspaper consumption, with a higher level

TABLE 3  
Outcomes of logistic regressions analyses

<i>News category</i>	<i>Predictors</i>	<i>B</i>	<i>Wald</i>	<i>e<sup>B</sup></i>
All	Constant	0.053	38.2	1.05
	Question format	1.1	38912	3.00
	Question age	-0.001	12321	0.999
	Education	0.101	5614	1.11
	Newspaper	0.079	4265	1.08
All with predictor sessions mean	Constant	-0.759	5518	0.47
	Question format	-1.16	41378	0.31
	Session mean	2.99	27807	19.89
	Question age	-0.001	11436	0.999
Domestic news	Constant	-0.672	672	0.51
	Question format	-1.23	7317	0.29
	Session mean	3.18	4794	24.04
	Question age	-0.9	2175	0.41
Foreign news	Constant	-0.94	2074	0.39
	Question format	-1.17	9883	0.31
	Session mean	2.96	6755	19.30
	Question age	-0.002	3061	0.998
Business	Constant	-1.01	507	0.36
	Question format	-0.961	1526	0.38
	Session mean	3.23	1629	25.28
	Question age	-0.001	392	0.999
	<b>Gender</b>	0.29	154	1.34
Entertainment	Constant	-0.534	485	0.59
	Question format	-1.19	8093	0.30
	Session mean	2.94	4290	18.92
	Question age	-0.001	1666	0.999
Crime	Constant	-0.357	67	0.70
	Question format	-1.473	3666	0.23
	Session mean	2.98	1459	19.69
	Question age	-0.001	631	0.999
Politics	Constant	-1.73	1760	0.18
	Question format	-1.28	4975	0.28
	Session mean	3.86	3806	47.47
	Question age	-0.002	1044	0.998
	<b>Education</b>	0.084	331	1.09
	<b>Age</b>	0.01	296	1.01
Disasters	Constant	-0.573	264	0.56
	Question format	-1.02	2732	0.36
	Session mean	2.36	1493	10.59
	Question age	-0.002	1329	0.998
Sports	Constant	-0.73	436	0.48
	Question format	-1.05	2908	0.35
	Session mean	2.68	1941	14.59

**Table 3** (Continued)

<i>News category</i>	<i>Predictors</i>	<i>B</i>	<i>Wald</i>	<i>e<sup>B</sup></i>
Science	Question age	-0.001	1015	0.999
	Constant	-1.11	352	0.33
	Question format	-1.22	1498	0.30
	Session mean	2.43	529	11.36
	Question age	-0.001	333	0.999
	<b>Education</b>	0.064	75	1.07

Predictors are listed in the order in which they entered the analysis (stepwise). For each predictor, the raw regression coefficient is given (*B*) and Wald's statistic on which significance testing was based. The exponential of *B* ( $e^B$ , last column) is easier to interpret than *B*. For each unit increase of the predictor, the odds of a correct response become larger or smaller by a factor  $e^B$ . Values close to 1 indicate small effects (i.e., there is little change in the odds of a correct response), large or values close to 0 indicate large effects. Demographic variables are printed in bold.

of education and a larger media consumption resulting in a higher likelihood of answering questions correctly. Effects of other variables fell below our criterion, but were nevertheless significant. Older and male participants answered questions more often correct than younger and female participants.

To isolate influences specific to categories, we entered one more predictor in the regression analyses below: mean performance on all other questions in the session (referred to in Table 3 as session mean). As mean performance should incorporate all effects of predictors that are not specific to categories, entering it as a predictor alongside the demographic ones allowed us to neutralise the nonspecific effects of those demographic predictors. Entering this predictor into the logistic regression analysis for all trials indeed led to the result that all demographic predictors fell below our criterion for inclusion in the regression formula (see second row in Table 3).

### Specific categories

We then looked at the coherence and separateness of the categories *vis-à-vis* one another. Since each participant only answered a small proportion of all questions in the database, standard techniques, such as scale analysis, are not suitable here. We therefore looked at dyads of questions answered by one participant. We computed the odds that if one member of the dyad was answered correctly, the others would be answered correctly as well. By dividing these odds with the odds that the second question was answered correctly, we created an odds ratio *O*:

$$O = \frac{p(c_i|c_j)/[1 - p(c_i|c_j)]}{p(c_i)/[1 - p(c_i)]}$$

Here, the numerator gives the odds that the event that some participant answered question  $i$  correctly (event  $c_i$ ) given that the same participant answered question  $j$  correctly (event  $c_j$ ). The denominator gives the unconditional odds that the participant answered question  $i$  correctly. Odds ratio  $O$  then reflects the increase in likelihood of answering question  $i$  correctly if the answer to  $j$  was correct. We estimated  $O$  from the results for questions within one category (e.g., where both  $i$  and  $j$  are sports news questions) and for questions not from the same category (e.g.,  $i$  is a sports question,  $j$  is a question from any other category). The resulting odds ratios are reported in the last two columns of Table 2. Coherent categories, as indicated by a higher odds ratio, were business, political, and sports news. Categories that were not coherent, as indicated by an odds ratio for same-category questions that were lower than that for different-category questions, were domestic, crime, disaster, and science news, with foreign news falling somewhat in between these two groups.

We then repeated the logistic regression analysis for trials in each category separately (in these analyses, dyads no longer played a role). For each category, question format had the largest effect, followed by mean performance on other questions in the session (shorthand as session mean). Another predictor that added to explained variance for all categories was the age of the question. Over and above their general effects, demographic variables affected performance to a degree above our criterion for a few categories. Gender affected performance on business news,  $p < .001$  by Wald's statistic (reported in Table 3), increase in Nagelkerke's  $R^2 = .005$ , with male participants performing better on these questions above and beyond their general advantage incorporated in the session mean. Performance on political news was affected, above and beyond general effects incorporated in session mean, by level of education,  $p < .001$ , increase in Nagelkerke's  $R^2 = .005$ , and age,  $p < .001$ , increase in Nagelkerke's  $R^2 = .005$ , with older and higher educated participants having performing better on these questions. Last, education affected performance on science news,  $p < .001$ , increase in Nagelkerke's  $R^2 = .005$ , with an advantage for higher educated participants. For all other categories of news, no demographic variable had effects above the threshold.

## DISCUSSION

Variables such as age, gender, media consumption, and educational attainment are known to influence the retention of news events (Howes & Katz, 1988; Kapur et al., 1998; Klomps, 2001; Meeter et al., 2005; Rubin et al.,

1999; Storandt et al., 1978). Here, we investigated whether such variables can also predict retention of categories of news, above and beyond general effects on performance. This turned out to be only limitedly the case. Although effects of almost all demographic variables on virtually all categories were significant due to our large sample, they were generally very small. Larger effects, those exceeding our threshold, were few in number: Older adults performed better on political news, men on business news, and those with higher educational attainment on both political and science news.

One reason for this general lack of effect is that performance on many categories turned out not to be very specific. Even within a well-defined category, such as crime stories, responses to within-category question dyads did not cohere more strongly than they did with questions from other categories. This suggests that to a large extent, participants follow news from all categories equally well, without strong specialisation. The exceptions are sports, business, and political news, which do seem to be more distinct from other categories of news. It is probably no coincidence that two of these were also categories on which we could detect effects of demographic variables. The third category with such an effect, science news, was one of the least distinctive in terms of response patterns. That educational attainment nevertheless had a measurable effect on retention from this category is somewhat surprising.

Participants were volunteers who participated via the Internet. As a group, they are unlikely to be a representative sample of the population: Internet denizens tend to have a higher education, be younger, and are more often male than the population as a whole. Nevertheless, the variation within the sample was very large, and deviations from the general population were not that substantial (see Meeter et al., 2005, for a comparison of our Internet samples and the general population). It is therefore unlikely that our results were due to a restriction of range, or are only applicable to Internet samples.

At a practical level, the results are good news for the construction of news events tests for remote memory (e.g., Leplow & Dierks, 1997; Mayes et al., 1994; Meeter et al., 2006; Sanders & Warrington, 1971; Squire & Slater, 1975). From the perspective of testing memory, effects of demographic variables on performance would count as bias if they would reflect differences in interest and not differences in memory functioning. The fact that media consumption is the strongest predictor of scores suggests that interest is indeed the stronger factor (Kapur et al., 1998; Meeter et al., 2005). Category-specific effects of demographic variables would be almost guaranteed to be due to differences in levels of interest (e.g., it is very unlikely that a person would have a memory system that was specifically suited to retain sports news). Such effects seem restricted to the categories of political,

science, and business news. Our results suggest that these categories can better be avoided in the construction of news events tests for remote memory.

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