Memories of colonoscopy: a randomized trial

Donald A. Redelmeier[a,b,c,d,e,*], Joel Katz[f,g,h,i], Daniel Kahneman[j,k]

[a]*Department of Medicine, University of Toronto, Toronto, Ontario, Canada*
[b]*Department of Health Policy Management and Evaluation, University of Toronto, Toronto, Ontario, Canada*
[c]*The Clinical Epidemiology and Health Care Research program, University of Toronto, Toronto, Ontario, Canada*
[d]*Sunnybrook and Women's College Health Science Centre, G-151, 2075 Bayview Ave, Toronto, Ontario, M4M 3M5 Canada*
[e]*The Institute for Clinical Evaluative Science in Ontario, 2075 Bayview Ave, Toronto, Ontario, M4M 3M5 Canada*
[f]*Department of Public Health Sciences, University of Toronto, Toronto, Ontario, Canada*
[g]*Department of Anaesthesia, University of Toronto, Toronto, Ontario, Canada*
[h]*Department of Anaesthesia and Pain Management, Toronto General Hospital, 200 Elizabeth Street, Toronto, Ontario, M5G 2C4, Canada*
[i]*Department of Anaesthesia and Pain Management, Mount Sinai Hospital, 600 University Avenue, Toronto, Ontario, M5G 1X5, Canada*
[j]*Department of Psychology, Princeton University, Princeton, NJ, USA*
[k]*Department of Public Affairs, Princeton University, Princeton, NJ, USA*

Abstract

Patients' memories of the past may influence their decisions about the future, yet memories are imperfect and susceptible to bias. We tested whether a memory failure observed in psychology experiments could be applied in a clinical setting to lessen patients' memories of the pain of an unpleasant medical procedure. We studied consecutive outpatients undergoing colonoscopy who were medically stable, mentally competent, and able to speak English ($n = 682$). By random assignment, half the patients had a short interval added to the end of their procedure during which the tip of the colonoscope remained in the rectum. Pain during the procedure was measured with a ten point intensity scale. Memory following the procedure was measured using both a rating scale and a ranking task. Randomization resulted in two similar groups. As theorized, patients who underwent the extended procedure experienced the final moments as less painful (1.7 vs. 2.5 on a ten point intensity scale, $P < 0.001$), rated the entire experience as less unpleasant (4.4 vs. 4.9 on a 10 cm visual analogue scale, $P = 0.006$), and ranked the procedure as less aversive compared to seven other unpleasant experiences (4.1 vs. 4.6 with eight as the worst, $P = 0.002$). Rates of returning for a repeat colonoscopy (median duration of follow-up 5.3 years) averaged 50.4% and were slightly higher (odds ratio = 1.41, $P = 0.038$) for those who underwent the longer procedure controlling for prior colonoscopy, procedure indications, and abnormal findings. Memory failures observed in experimental conditions can be found in clinical settings involving awake patients and may offer opportunities for improving patients' willingness to undergo future unpleasant medical procedures.

Keywords: Memory failure; Duration neglect; Randomized trial

1. Introduction

Colorectal cancer is a leading cause of death in the United States, with about 150,000 new cases and 60,000 deaths annually (Silverberg et al., 1990). A 50-year-old person has a 5% risk of having colorectal cancer by age 80 and a 2.5% risk of dying from it (Seidman et al., 1985). In an effort to reduce the morbidity and mortality due to colorectal cancer, authorities recommend periodic screening of persons at risk for this disease (Winawer et al., 1997; Burt, 2000; Imperiale et al., 2000). Colonoscopy is the colorectal screening procedure associated with the largest clinical benefit, highest direct costs, and greatest scientific debate (Goldman, 1989; Lieberman et al., 2000). As with other safe and accurate screening procedures, the contribution of colonoscopy to reducing deaths from colon cancer depends heavily on patients' willingness to undergo the procedure (Redelmeier, 1995; Frazier et al., 2000).

Patients' memories of unpleasant medical procedures influence their decisions about future treatment choices (Erskine et al., 1990). About 20% of women who refuse

* Corresponding author. Tel.: +1-416-480-6999; fax: +1-416-480-6048.
E-mail address: dar@ices.on.ca (D.A. Redelmeier).

mammography cite the pain of previous examinations as their sole reason for not following subsequent screening recommendations (Baines et al., 1990). Almost 10% of individuals who fail to visit a dentist describe the discomfort experienced during previous treatments when explaining their reluctance (Kent, 1985). About 40% of patients who are mentally competent after surviving a cardiac arrest choose to forgo future resuscitation efforts, at least in part because of what they recall from their treatment (Bedell et al., 1983). These observations indicate that even a temporary noxious experience can have an enduring effect on patients' behavior.

Psychology research has suggested that memory is imperfect and susceptible to bias. In particular, episodes of pain appear to be represented in memory by the features of particular moments, and the overall evaluation of an episode is determined mainly by the characteristics of these selected times (Varey and Kahneman, 1992; Frederickson and Kahneman, 1993; Kahneman et al., 1993; Stone et al., 2000; Diener et al., 2001). The duration of the episode has relatively little effect on subsequent evaluations, whereas the worst part of the experience and the amount of pain just before the episode ends are weighted heavily in the final impression. We tested whether these memory patterns might provide a non-pharmacologic approach to altering patients' memories of a painful medical procedure and improving return rates for subsequent colonoscopy procedures.

2. Methods

2.1. Patient context

We recruited outpatients who had an indication for colonoscopy and presented between November 7, 1994 and December 12, 1995. No colonoscopy was performed solely for research. Patients were excluded if they did not speak English, had major cognitive limitations, or suffered from a severe comorbid disease. The hospital had capacity to conduct colonoscopy simultaneously in three different rooms: in such circumstances the first available patient was selected. Each patient provided written consent and the protocol was approved by the Wellesley Hospital Human Ethics Committee including the use of real-time evaluations to deflect attention and maintain patient blinding. Scheduling of follow-up was organized by administrative staff in the responsible physician's office who were unaware of the research protocol.

2.2. Randomization and blinding

Unlike most trials, the study entailed real-time assignment during the procedure. Sealed, opaque, numbered envelopes containing instructions for the intervention (standard care or modified care) were prepared for individual patients according to a prespecified, concealed, computerized, unblocked, randomization schedule. Envelopes were assigned to each patient at the start of the colonoscopy but only opened at the final stage of the procedure, defined as when the tip of the colonoscope entered the cecum or the attending physician judged that further insertion was not feasible. Delaying disclosure until the final stage ensured that clinicians would not consciously or unconsciously alter other stages of the procedure. At no point were patients informed which group they were in or whether an intervention was initiated.

2.3. Description of intervention

Modified care consisted of a non-pharmacologic intervention designed to lessen patients' memory of the pain of colonoscopy. The goal was to minimize the level of pain during the final minutes of the procedure and thereby allow the patient to retain a more positive memory of the experience. To do so, the tip of the colonoscope was allowed to rest in the rectum for up to 3 min prior to removal (no suction, inflation, or added anaesthetic). Thus, modified care lengthened the duration of the procedure but resulted in final moments that were less painful. Our hypothesis was that the intervention might lessen patient's memory of the pain of colonoscopy and allow individuals to retain a more favorable (less unfavorable) impression of the experience. To maintain patient blinding we asked all clinical staff to remain in position with unchanged behavior.

2.4. Real-time evaluations

We used the Gottman–Levenson approach for assessing pain during invasive medical procedures by eliciting moment-to-moment reports for the full interval to completion (Gottman and Levenson, 1985). Specifically, patients were given a hand-held device that controlled the position of a marker displayed on a computer screen. The computer presented an image similar to a thermometer, with end points denoted as 'no pain' and 'extreme pain'. By moving the device, or instructing the research assistant, the patient positioned the marker to indicate their current level of pain. The computer was programmed to begin 30 s after insertion of the colonoscope and prompted the patient for a pain rating at 60 s intervals until the colonoscope was removed.

2.5. Definition of terms

In the background, the computer tracked all movements of the marker and converted its position into a pain score that ranged between 0 and 10, where '0' indicated 'no pain' and '10' indicated 'extreme pain'. Five summary statistics were calculated for each patient. Duration denoted the time, in minutes, from insertion to removal of the colonoscope. Average-pain denoted the mean intensity during the entire procedure. Peak-pain denoted the intensity of pain at its

worst moment. Initial-pain, mid-pain, and final-pain denoted the mean intensity during the initial, middle, and final 3 min of the procedure, respectively. With the exception of duration, all summary statistics ranged from 0 to 10 where larger values indicated greater intensity.

2.6. Retrospective evaluations after colonoscopy

After the colonoscopy was finished and the effects of meperidine, midazolam, or other anaesthetic had abated, patients reflected on their experience and completed a self-administered questionnaire. Two measures were used to assess global evaluations. First, patients rated 'the total discomfort from the procedure', using a 10 cm visual analogue rating scale with end points labelled as 'no discomfort' and 'awful discomfort' (Katz and Melzack, 1999). Next, patients ranked 'the colonoscopy you just had' relative to a list of eight unpleasant personal events, such as 'an average visit to the dentist' and '2 days in bed with the flu' (Chapman et al., 1985). Past studies suggested that these two measures provide reliable and valid assessments of patients' short-term memories of the pain of colonoscopy (Redelmeier and Kahneman, 1996).

2.7. Subsequent return for follow-up colonoscopy

We measured patients' subsequent return rates by analyzing billing data from the Ministry of Health for the interval November 1, 1994 to August 1, 2000. In Ontario, colonoscopy is performed only by physicians, physicians are reimbursed only if a bill is sent to the Ministry, and the administrative databases record these submissions regardless of how a physician is eventually reimbursed. We searched databases by using encrypted patient identifiers and collected data on the first subsequent colonoscopy, regardless of where it was performed. Patients who returned at any time for a repeat colonoscopy were defined as adherent, regardless of whether they returned to the original facility and regardless of instructions they might have been given.

2.8. Statistical analysis

The principal analysis compared rates of returning for a subsequent colonoscopy in patients who received standard care and modified care. The sample size was calculated to provide an 80% chance of detecting a 10% change in return rates (Hulley and Cummings, 1988). Logistic regression was used to explore confounding due to age, gender, weight, height, body mass index, previous colonoscopy, education, specific indication, use of analgesia (of any type), abnormalities (present or absent), and interventions (present or absent). Rates of returning for a repeat colonoscopy were also analyzed according to retrospective evaluations (ratings and ranking tested separately to check robustness). All P-values were two tailed, calculated from intent-to-treat analyses, and analyzed using security protocols of the Institute for Clinical Evaluative Sciences.

3. Results

3.1. Descriptive overview

A total of 733 patients were approached and 682 agreed to participate. Those who declined were older (62 vs. 57 years, $P = 0.025$) and less likely to have a college education (40 vs. 60%, $P = 0.005$), but otherwise had similar distributions of gender and waiting times as those who participated. Patients randomized to modified care were similar to patients randomized to standard care in demographic characteristics (Table 1). In addition, the two groups of participants were similar in the indications, use of analgesia, findings, and interventions for colonoscopy (Table 2). Complications occurred in four patients (two in each group) characterized by post polypectomy bleeding (one), hypotension (one), hypoxemia (one), and equipment failure (one).

3.2. Real-time evaluations

We found no significant difference between the two groups in the level of pain during the initial part, the middle part, and the worst part of the colonoscopy procedure, thereby verifying successful blinding (Table 3). As expected, the level of pain during the final part of the procedure was lower for patients in the modified care group (1.7 vs. 2.5, $P < 0.001$). The overall duration of the colonoscopy was about 1 min longer for patients in the modified care group (27.6 vs. 26.8, $P > 0.20$). We found no significant correlation between the average intensity of pain during the procedure and the overall duration of the procedure ($r = 0.01$, $P > 0.20$), suggesting that longer procedures generally implied more total pain.

Some factors predicted whether a procedure would be particularly intense or long. Colonoscopy resulted in a higher average pain intensity for women than men (4.0 vs. 3.3, $P < 0.001$), in accord with past research (Fillingim, 2000). No differences were found for other factors in Table 1 after stratifying by gender. Patients who received analgesia had no significant trend toward higher average pain intensity (3.7 vs. 3.2, $P > 0.20$), perhaps due to confounding from self-selection. Patients over age 60 years required about 2.6 more minutes (28.6 vs. 26.0, $P = 0.022$) and those with college education required 2.5 fewer minutes (26.1 vs. 28.6, $P = 0.031$) than other patients, on average. Neither gender, height, weight, or use of analgesia was associated with a longer procedure duration.

3.3. Retrospective evaluations

Patients varied substantially in the memories for the total

Table 1
Patient characteristics

		Conventional procedure ($n = 345$)	Modified procedure ($n = 337$)
Age (years)	20–39	13	12
	40–59	40	41
	60–79	40	39
	80–99	7	7
Gender (% male)		48	55
Weight (kg)	40–59	23	17
	60–79	45	49
	80–99	27	29
	≥100	5	5
Height (cm)	140–154	7	7
	155–169	42	35
	170–184	44	52
	185–200	6	7
Body mass index (kg/m^2)	15–19	11	10
	20–24	42	44
	25–29	36	33
	≥30	11	13
Education (highest level)	Below High School	10	12
	High School	29	29
	College	42	42
	Postgraduate	19	17
Previous colonoscopy?		47	41

Data are % in each group, which may not add exactly to 100 due to rounding.

pain experienced. Patients who received the modified procedure remembered less total pain, in accord with the prespecified hypothesis and despite the real-time evaluations, as indicated by a 10% lower mean rating on the visual analogue scale (Table 4). In addition, patients who received modified care generally ranked the procedure as less unpleasant compared to the other seven aversive experiences. Similar findings were observed after adjustment for factors in Tables 1 and 2. These average results were corroborated by data on the proportion of patients who assigned the worst visual analogue scale rating to the procedure (3.3 vs. 6.7%, $P = 0.039$) and by the proportion who ranked colonoscopy as the worst of all the aversive personal experiences (8.3 vs. 14.0%, $P = 0.018$).

Memories of colonoscopy pain correlated with some aspects of the real-time evaluations ($P < 0.05$). As expected, both the visual analogue scale ratings and the aversive experience rankings correlated with the peak-pain ($r = 0.44$ and 0.26, respectively), the initial-pain ($r = 0.32$ and 0.19, respectively), the mid-pain ($r = 0.40$ and 0.24, respectively), the final-pain ($r = 0.33$ and 0.22, respectively), and the average pain level ($r = 0.56$ and 0.33, respectively). The duration of colonoscopy did not accurately predict how the procedure would be remembered by patients ($r = 0.10$ and 0.09, respectively), a finding that was also observed in analyses confined to just those patients who received no anaesthetic ($r = 0.01$ and 0.12, respectively).

3.4. Subsequent colonoscopy

The median follow-up was 5.3 years and about half of the patients returned for a repeat colonoscopy (Table 5). The intervention had no large general effect on increasing subsequent return rates (53 vs. 48%, $P > 0.20$). Logistic regression indicated that this was equivalent to an 18% relative increase in the odds of returning for a repeat colonoscopy (95% confidence interval: −13–59, $P > 0.20$). Taking into account the patient's prior history, specific indications, and abnormal findings (the three significant predictors in step-wise regression) yielded a 41% increase in the odds of returning (95% confidence interval: 2–96, $P = 0.038$). Patients who had bleeding as their indication for colonoscopy, regardless of whether they had a prior colonoscopy or abnormalities detected, experienced the largest increase in rates of returning (odds ratio: 3.01, 95% confidence interval: 1.2–7.39, $P = 0.014$).

Three clinical factors were strong predictors of a subsequent colonoscopy. Namely, a positive past history,

Table 2
Description of procedures[a]

		Conventional procedure	Modified procedure
Indication	Pain	19	22
	Blood in stool	11	12
	Anemia	5	6
	Change in bowel movements	14	16
	Screening	19	16
	Follow-up	27	22
	Other[b]	5	5
Meperidine	None	18	15
	Small (up to and including 50 mg)	65	69
	Medium (between 50 and 100 mg)	15	15
	Large (more than 100 mg)	1	0
Midazolam	None	12	11
	Small (up to and including 3 mg)	54	53
	Medium (between 3 and 6 mg)	31	32
	Large (more than 6 mg)	3	3
Received other anaesthetic medications?		3	5
Received no anaesthetic medications?		12	10
Findings	Normal	46	54
	Single polyp	16	15
	Multiple polyps	17	15
	Colitis/proctitis	9	7
	Angiodysplasia	1	1
	Diverticular disease	5	4
	Hemorrhoids	1	2
	Mass lesion	1	1
	Other[c]	3	2
Intervention	Biopsy	2	2
	Snare	12	12
	Other[d]	1	1

[a] Data are % in each group.
[b] Includes weight loss, colitis assessment (either Crohn's or ulcerative colitis) radiologic abnormalities, and non-specific complaints.
[c] Includes melanosis coli, varices, Kaposi's sarcoma, granuloma, stricture, helminths, unknown, or inadequate examination.
[d] Includes dilation, cautery.

the clinical indication for the procedure being 'follow-up', and the detection of abnormal findings each predicted an increased likelihood of returning for colonoscopy (Table 5). No other demographic characteristic (Table 1), procedure factor (Table 2), or real-time pain intensity (Table 3) significantly predicted return rates. As expected, retrospective visual analogue scale ratings and aversive experience rankings (Table 4) correlated with decreased return rates ($P < 0.020$, for both measures). For example, those who ranked colonoscopy as the worst of all the aversive experiences were less likely to return than those who ranked colonoscopy as the best of all the aversive experiences (45 vs. 64%, $P = 0.016$).

Table 3
Real-time experiences[a,b]

	Conventional procedure	Modified procedure
Initial pain	3.7 ± 2.5	3.4 ± 2.4
Middle pain	3.8 ± 3.0	3.6 ± 2.8
Final pain[c]	2.5 ± 2.4	1.7 ± 2.0
Peak pain	8.1 ± 2.3	8.0 ± 21.2
Average pain	3.7 ± 2.0	3.5 ± 1.8
Duration (min)	27 ± 15	28 ± 14

[a] Data are means and standard deviations for each group.
[b] Pain range from 0 to 10 where bigger numbers indicate more intensity.
[c] $P < 0.001$ for difference between two groups, all other differences $P > 0.10$.

Stratified analyses examined memory and behavior according to the propensity to return for colonoscopy. Patients with two or three of the predictors were classified as having a high propensity of returning ($n = 256$). Patients with one or zero predictors were classified as having a low propensity of returning ($n = 426$). We found the intervention's effect on retrospective ratings was similar for patients who had a high propensity (3.9 vs. 4.7, $P = 0.010$)

Table 4
Retrospective evaluations[a]

	Conventional procedure	Modified procedure	*P*-value
Visual analogue scale[b]			
Crude analysis	4.9 ± 2.6	4.4 ± 2.5	0.006
Adjusted for demographics[c]	4.9 ± 2.5	4.4 ± 2.4	0.006
Adjusted for prior experience	4.9 ± 2.6	4.4 ± 2.5	0.002
Adjusted for use of anaesthetic	4.9 ± 2.6	4.4 ± 2.5	0.006
Adjusted for all three	4.9 ± 2.5	4.4 ± 2.4	0.002
Relative ranking judgement[d]			
Crude analysis	4.6 ± 2.1	4.1 ± 2.1	0.002
Adjusted for demographics[c]	4.6 ± 2.1	4.1 ± 2.1	0.002
Adjusted for prior experience	4.6 ± 2.1	4.1 ± 2.1	0.002
Adjusted for use of anaesthetic	4.6 ± 2.1	4.1 ± 2.1	0.002
Adjusted for all three	4.6 ± 2.0	4.1 ± 2.1	0.002

[a] Data are means and standard deviations for each group.
[b] Range 0–10, bigger indicates worse pain.
[c] Demographics are age, gender, weight, height, eduation.
[d] Range 1–8, bigger indicates worse pain.

and patients who had a low propensity of returning (4.6 vs. 5.1, $P = 0.065$). The effect on retrospective rankings was also consistent for those who had a high and a low propensity of returning. The effect on return rates was negligible for those who had a high propensity of returning (72 vs. 71%, $P > 0.20$) and moderate for those who had a low propensity of returning (43 vs. 32%, $P = 0.023$).

4. Discussion

We tested a non-pharmacological method for changing patients' memories of colonoscopy. We found that colonoscopy was unpleasant for the average patient, produced aversive short-term memories, and resulted in only about half of patients returning for a repeat procedure after 5 years. In agreement with theory, adding a short interval of minimal discomfort to the final moments of the procedure caused patients to retain a more favorable (less aversive) overall memory of the experience. The intervention caused about a 10% relative decrease in the overall memory of pain, a 10% relative increase in the number of patients who returned for follow-up, and suggested that more effective interventions are needed in practice.

Our research has limitations because it is a proof-of-concept study on the psychology of long-term recall. As a consequence, we do not know what might happen from more extensive efforts to address a patient's perceptions. Colono-

Table 5
Rates of return[a]

	Conventional procedure	Modified procedure	Number needed to treat
Previous colonoscopy			
Yes	67	67	N/A[b]
No	32	42	10
Indication for colonoscopy			
Pain	32	39	15
Blood in stool	36	63	4
Anemia	39	58	5
Change in bowel movements	33	38	21
Screening	49	49	N/A[b]
Follow-up	73	73	N/A[b]
Other[c]	59	47	−9
Findings from colonoscopy			
Normal	35	44	12
Abnormal[c]	60	63	33

[a] Data are % in each group who subsequently return.
[b] N/A indicates outside range from −200 to +200.
[c] As defined in Table 2.

scopy involves possible indignities and other drawbacks; hence, memories are not the only factor influencing a patient's behavior. Repeat colonoscopy is not always needed, we do not know what each patient was told after the procedure, and significant differences in return rates were only found after controlling for major clinical features (history, indications, abnormalities). Testing more intense interventions remains a topic for future research, yet such studies will face major obstacles in maintaining patient blinding. At present, we found about half of patients undergoing colonoscopy do not return for follow-up by 5 years and that, among those with a low propensity of returning, the behavioral intervention yields one more return for every nine patients treated.

The fallibility of memory has been documented for decades in psychological science even when tested under brief conditions. Past research indicates that the distortions in memory are not entirely random; instead, systematic failures occur that are repeated by most people and that are predictable in advance. Our findings support past research that overall memory is created by recalling selected moments rather than an exact running total of the experience. The duration of an episode has relatively small influence unless it is highly salient (e.g. the wait for surgery) or correlated with intensity (e.g. the duration of labor). Last impressions may be lasting impressions when people reflect on past life experiences.

In medicine, patients attach memories to past experiences and these memories are sometimes worth improving because they inform future decisions or because they are inherently unpleasant. Our study suggests one way in which the basic science of psychology might inform clinical practice. Potential future medical applications and research must acknowledge the demands for cost-effectiveness, the need for improved technologies, and the ethical tension between the fallibility of human reasoning and the imperative toward patient autonomy (Kahneman, 1994, 2000a,b; Schreiber and Kahneman, 2000). Yet none of these additional issues justifies neglecting the principles of human psychology because the patient's perspective will always be an essential element in medical care.

Memories are imperfect, so that sometimes things seem better even though they are not. Patients who experience pain during colonoscopy may be prone to recall the experience as unpleasant if the procedure ceases soon after the worst moment. Patients who undergo similar examinations, except that the ending is extended allowing the pain to subside gradually, may recall the procedure relatively more favorably (less unfavorably). The implication of this concept is that physicians might wish to use special gentleness and care at the end of an aversive procedure conducted on an awake patient, particularly if the patient has had no previous procedure and no abnormalities detected. Doing so is often feasible, would not compromise technique, and might yield an improvement in the number who return for a subsequent procedure.

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