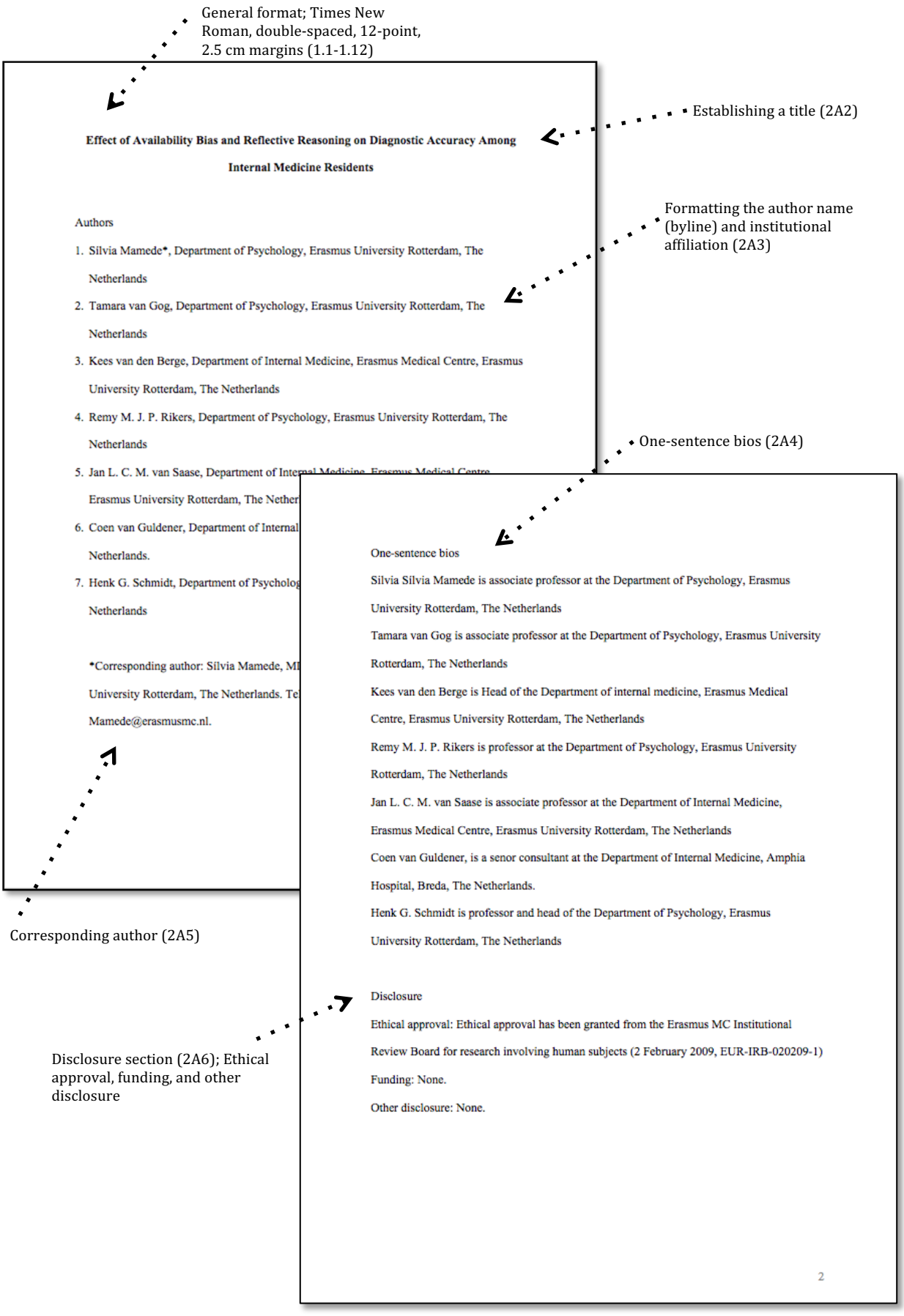
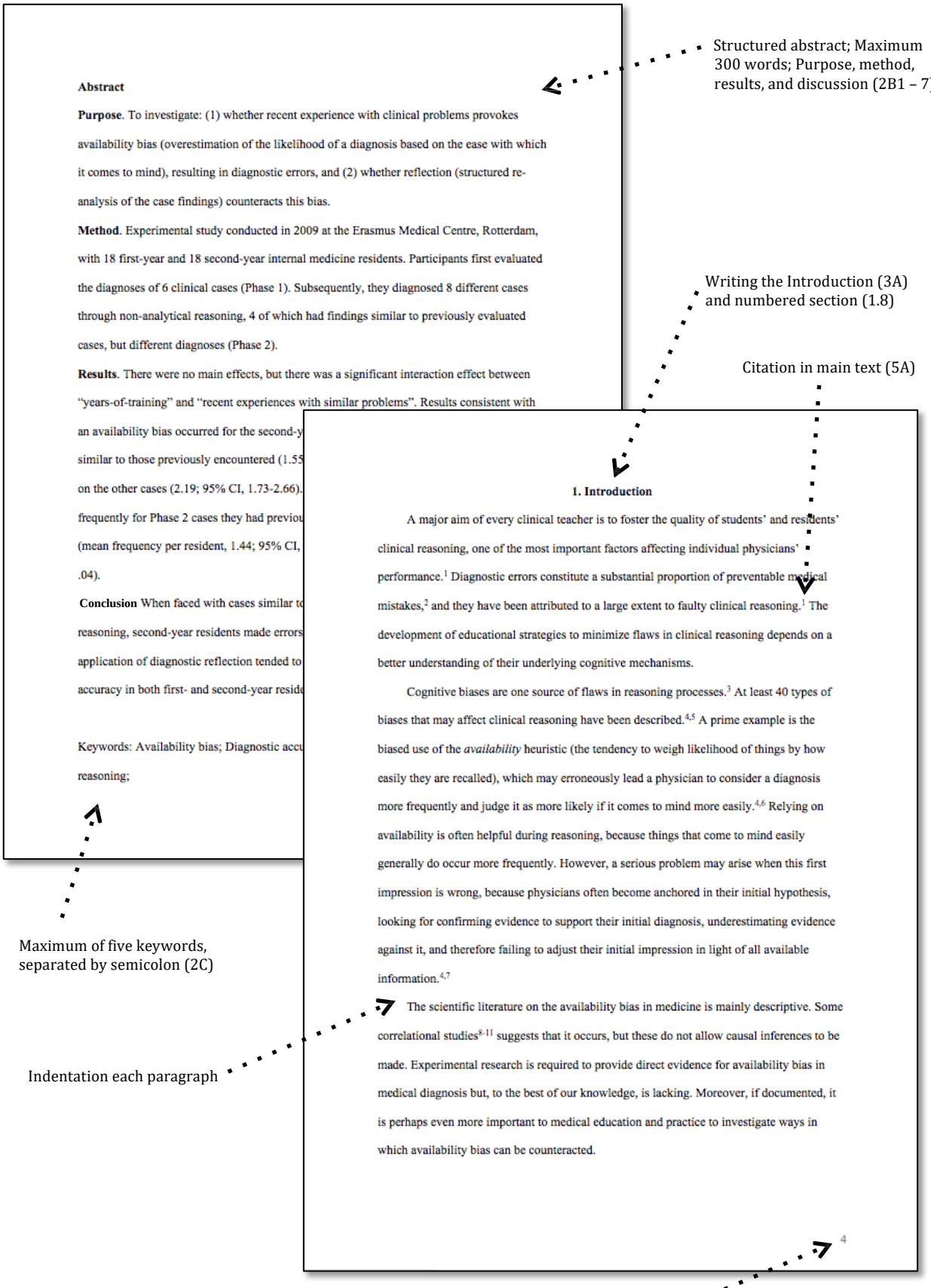
Health Professions Education

Author Guidelines

Publications in Health Professions Education generally follow the guidelines of the American Medical Association (AMA) Manual of Style: https://www.amamanualofstyle.com Please check these while preparing a manuscript for publication.

An alternative is using the guidelines provided by the Sample Manuscript *which you will find on the next pages.* The journal generally only accepts manuscripts that are formatted according to these guidelines.


General format; Times New Roman, double-spaced, 12-point, 2.5 cm margins (1.1-1.12)
Establishing a title (2A2)
Effect of Availability Bias and Reflective Reasoning on Diagnostic Accuracy Among Internal Medicine Residents
Formatting the author name (byline) and institutional affiliation (2A3)
Authors
1. Silvia Mamede*, Department of Psychology, Erasmus University Rotterdam, The Netherlands
2. Tamara van Gog, Department of Psychology, Erasmus University Rotterdam, The Netherlands
3. Kees van den Berge, Department of Internal Medicine, Erasmus Medical Centre, Erasmus University Rotterdam, The Netherlands
4. Remy M. J. P. Rikers, Department of Psychology, Erasmus University Rotterdam, The Netherlands
5. Jan L. C. M. van Saase, Department of Internal Medicine, Erasmus Medical Centre, Erasmus University Rotterdam, The Nether
6. Coen van Guldener, Department of Internal
Netherlands.
7. Henk G. Schmidt, Department of Psycholog
Netherlands
*Corresponding author: Silvia Mamede, MI
University Rotterdam, The Netherlands. Te
Mamede@erasmusmc.nl.
One-sentence bios (2A4)
One-sentence bios
Silvia Silvia Mamede is associate professor at the Department of Psychology, Erasmus University Rotterdam, The Netherlands
Tamara van Gog is associate professor at the Department of Psychology, Erasmus University Rotterdam, The Netherlands
Kees van den Berge is Head of the Department of internal medicine, Erasmus Medical Centre, Erasmus University Rotterdam, The Netherlands
Remy M. J. P. Rikers is professor at the Department of Psychology, Erasmus University Rotterdam, The Netherlands
Jan L. C. M. van Saase is associate professor at the Department of Internal Medicine, Erasmus Medical Centre, Erasmus University Rotterdam, The Netherlands
Coen van Guldener, is a senor consultant at the Department of Internal Medicine, Amphia Hospital, Breda, The Netherlands.
Henk G. Schmidt is professor and head of the Department of Psychology, Erasmus University Rotterdam, The Netherlands
Corresponding author (2A5)
Disclosure
Ethical approval: Ethical approval has been granted from the Erasmus MC Institutional Review Board for research involving human subjects (2 February 2009, EUR-IRB-020209-1)
Funding: None.
Other disclosure: None.
Disclosure section (2A6); Ethical approval, funding, and other disclosure
2



Abstract

Purpose. To investigate: (1) whether recent experience with clinical problems provokes availability bias (overestimation of the likelihood of a diagnosis based on the ease with which it comes to mind), resulting in diagnostic errors, and (2) whether reflection (structured re-analysis of the case findings) counteracts this bias.

Method. Experimental study conducted in 2009 at the Erasmus Medical Centre, Rotterdam, with 18 first-year and 18 second-year internal medicine residents. Participants first evaluated the diagnoses of 6 clinical cases (Phase 1). Subsequently, they diagnosed 8 different cases through non-analytical reasoning, 4 of which had findings similar to previously evaluated cases, but different diagnoses (Phase 2).

Results. There were no main effects, but there was a significant interaction effect between "years-of-training" and "recent experiences with similar problems". Results consistent with an availability bias occurred for the second-y
similar to those previously encountered (1.55
on the other cases (2.19; 95% CI, 1.73-2.66).
frequently for Phase 2 cases they had previou
(mean frequency per resident, 1.44; 95% CI,
.04).

Conclusion When faced with cases similar t
reasoning, second-year residents made errors
application of diagnostic reflection tended to
accuracy in both first- and second-year reside

Keywords: Availability bias; Diagnostic accu
reasoning;

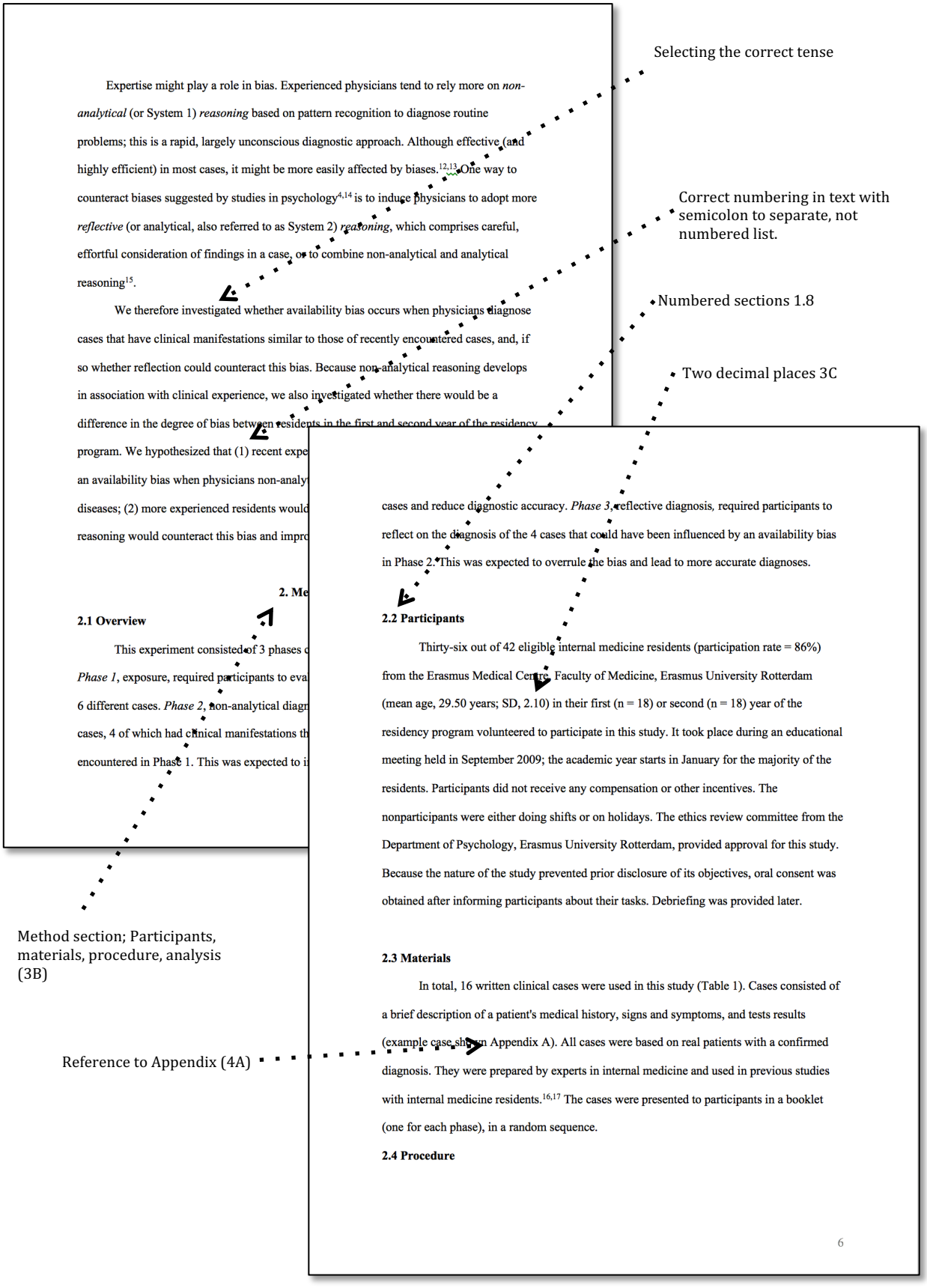
1. Introduction

A major aim of every clinical teacher is to foster the quality of students' and residents' clinical reasoning, one of the most important factors affecting individual physicians' performance.[1] Diagnostic errors constitute a substantial proportion of preventable medical mistakes,[2] and they have been attributed to a large extent to faulty clinical reasoning.[1] The development of educational strategies to minimize flaws in clinical reasoning depends on a better understanding of their underlying cognitive mechanisms.

Cognitive biases are one source of flaws in reasoning processes.[3] At least 40 types of biases that may affect clinical reasoning have been described.[4,5] A prime example is the biased use of the *availability* heuristic (the tendency to weigh likelihood of things by how easily they are recalled), which may erroneously lead a physician to consider a diagnosis more frequently and judge it as more likely if it comes to mind more easily.[4,6] Relying on availability is often helpful during reasoning, because things that come to mind easily generally do occur more frequently. However, a serious problem may arise when this first impression is wrong, because physicians often become anchored in their initial hypothesis, looking for confirming evidence to support their initial diagnosis, underestimating evidence against it, and therefore failing to adjust their initial impression in light of all available information.[4,7]

The scientific literature on the availability bias in medicine is mainly descriptive. Some correlational studies[8-11] suggests that it occurs, but these do not allow causal inferences to be made. Experimental research is required to provide direct evidence for availability bias in medical diagnosis but, to the best of our knowledge, is lacking. Moreover, if documented, it is perhaps even more important to medical education and practice to investigate ways in which availability bias can be counteracted.

4



Expertise might play a role in bias. Experienced physicians tend to rely more on *non-analytical* (or System 1) *reasoning* based on pattern recognition to diagnose routine problems; this is a rapid, largely unconscious diagnostic approach. Although effective (and highly efficient) in most cases, it might be more easily affected by biases.[12,13] One way to counteract biases suggested by studies in psychology[4,14] is to induce physicians to adopt more *reflective* (or analytical, also referred to as System 2) *reasoning*, which comprises careful, effortful consideration of findings in a case, or to combine non-analytical and analytical reasoning[15].

We therefore investigated whether availability bias occurs when physicians diagnose cases that have clinical manifestations similar to those of recently encountered cases, and, if so whether reflection could counteract this bias. Because non-analytical reasoning develops in association with clinical experience, we also investigated whether there would be a difference in the degree of bias between residents in the first and second year of the residency program. We hypothesized that (1) recent expe

an availability bias when physicians non-analy

diseases; (2) more experienced residents would

reasoning would counteract this bias and impro

2. Me

2.1 Overview

This experiment consisted of 3 phases o

Phase 1, exposure, required participants to eva

6 different cases. *Phase 2*, non-analytical diagn

cases, 4 of which had clinical manifestations th

encountered in Phase 1. This was expected to i

cases and reduce diagnostic accuracy. *Phase 3*, reflective diagnosis, required participants to reflect on the diagnosis of the 4 cases that could have been influenced by an availability bias in Phase 2. This was expected to overrule the bias and lead to more accurate diagnoses.

2.2 Participants

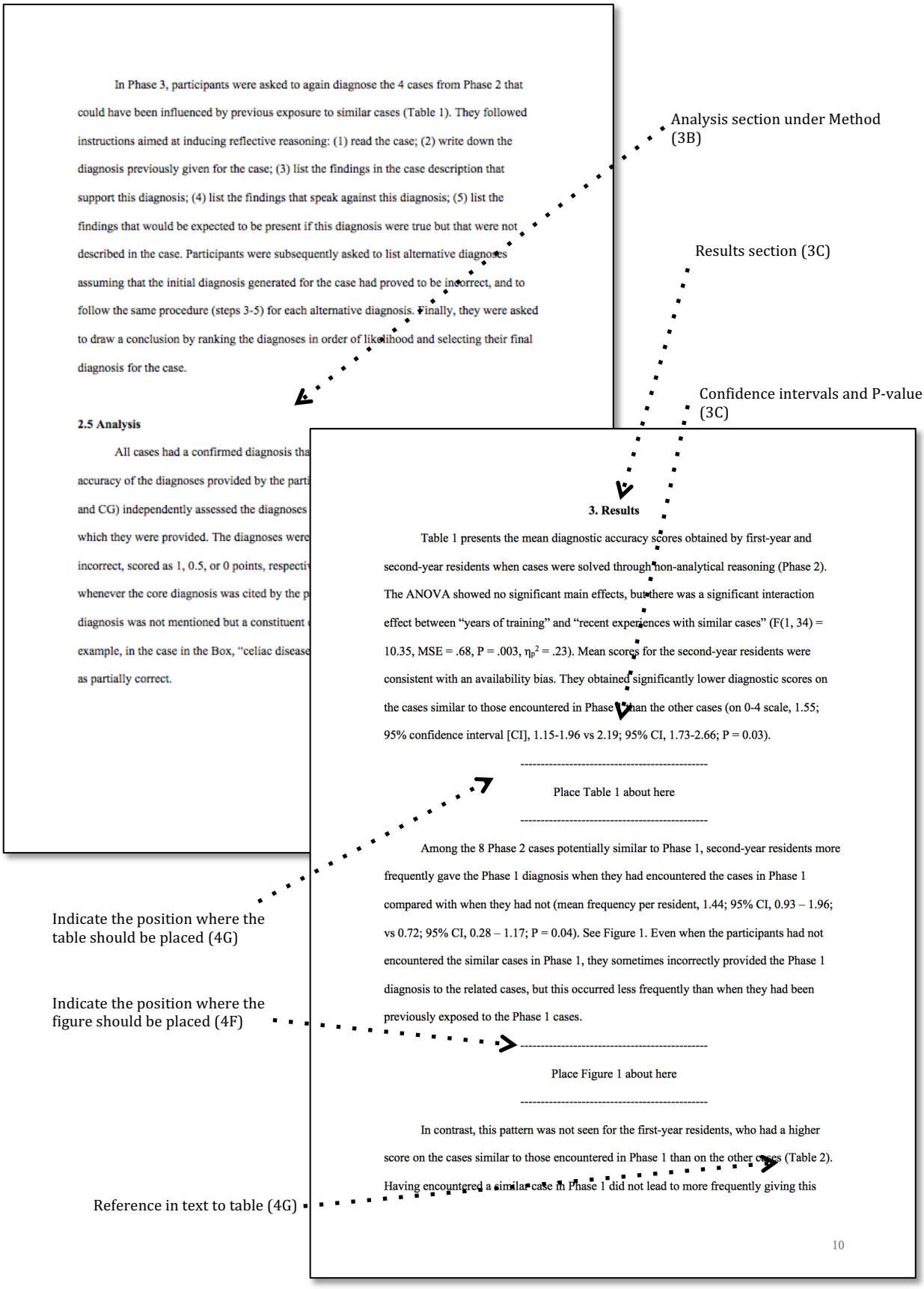
Thirty-six out of 42 eligible internal medicine residents (participation rate = 86%) from the Erasmus Medical Center, Faculty of Medicine, Erasmus University Rotterdam (mean age, 29.50 years; SD, 2.10) in their first (n = 18) or second (n = 18) year of the residency program volunteered to participate in this study. It took place during an educational meeting held in September 2009; the academic year starts in January for the majority of the residents. Participants did not receive any compensation or other incentives. The nonparticipants were either doing shifts or on holidays. The ethics review committee from the Department of Psychology, Erasmus University Rotterdam, provided approval for this study. Because the nature of the study prevented prior disclosure of its objectives, oral consent was obtained after informing participants about their tasks. Debriefing was provided later.

2.3 Materials

In total, 16 written clinical cases were used in this study (Table 1). Cases consisted of a brief description of a patient's medical history, signs and symptoms, and tests results (example case shown Appendix A). All cases were based on real patients with a confirmed diagnosis. They were prepared by experts in internal medicine and used in previous studies with internal medicine residents.[16,17] The cases were presented to participants in a booklet (one for each phase), in a random sequence.

2.4 Procedure

6



In Phase 3, participants were asked to again diagnose the 4 cases from Phase 2 that could have been influenced by previous exposure to similar cases (Table 1). They followed instructions aimed at inducing reflective reasoning: (1) read the case; (2) write down the diagnosis previously given for the case; (3) list the findings in the case description that support this diagnosis; (4) list the findings that speak against this diagnosis; (5) list the findings that would be expected to be present if this diagnosis were true but that were not described in the case. Participants were subsequently asked to list alternative diagnoses assuming that the initial diagnosis generated for the case had proved to be incorrect, and to follow the same procedure (steps 3-5) for each alternative diagnosis. Finally, they were asked to draw a conclusion by ranking the diagnoses in order of likelihood and selecting their final diagnosis for the case.

2.5 Analysis

All cases had a confirmed diagnosis tha
accuracy of the diagnoses provided by the parti
and CG) independently assessed the diagnoses
which they were provided. The diagnoses were
incorrect, scored as 1, 0.5, or 0 points, respectiv
whenever the core diagnosis was cited by the p
diagnosis was not mentioned but a constituent
example, in the case in the Box, "celiac disease
as partially correct.

3. Results

Table 1 presents the mean diagnostic accuracy scores obtained by first-year and second-year residents when cases were solved through non-analytical reasoning (Phase 2). The ANOVA showed no significant main effects, but there was a significant interaction effect between "years of training" and "recent experiences with similar cases" ($F(1, 34) = 10.35$, MSE = .68, P = .003, $\eta_p^2 = .23$). Mean scores for the second-year residents were consistent with an availability bias. They obtained significantly lower diagnostic scores on the cases similar to those encountered in Phase 1 than the other cases (on 0-4 scale, 1.55; 95% confidence interval [CI], 1.15-1.96 vs 2.19; 95% CI, 1.73-2.66; P = 0.03).

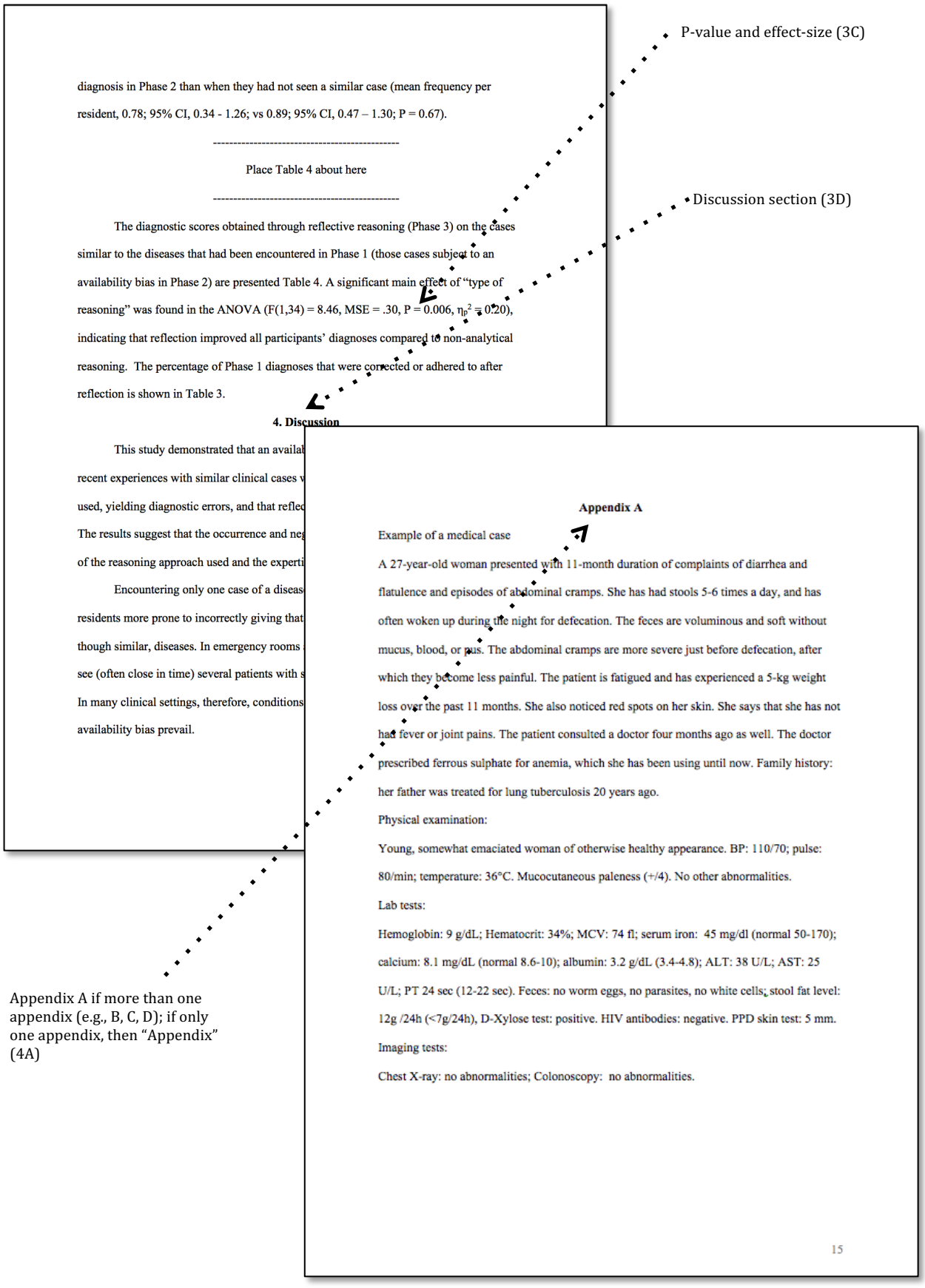
Place Table 1 about here

Among the 8 Phase 2 cases potentially similar to Phase 1, second-year residents more frequently gave the Phase 1 diagnosis when they had encountered the cases in Phase 1 compared with when they had not (mean frequency per resident, 1.44; 95% CI, 0.93 – 1.96; vs 0.72; 95% CI, 0.28 – 1.17; P = 0.04). See Figure 1. Even when the participants had not encountered the similar cases in Phase 1, they sometimes incorrectly provided the Phase 1 diagnosis to the related cases, but this occurred less frequently than when they had been previously exposed to the Phase 1 cases.

Place Figure 1 about here

In contrast, this pattern was not seen for the first-year residents, who had a higher score on the cases similar to those encountered in Phase 1 than on the other cases (Table 2). Having encountered a similar case in Phase 1 did not lead to more frequently giving this

10



diagnosis in Phase 2 than when they had not seen a similar case (mean frequency per resident, 0.78; 95% CI, 0.34 - 1.26; vs 0.89; 95% CI, 0.47 – 1.30; P = 0.67).

Place Table 4 about here

The diagnostic scores obtained through reflective reasoning (Phase 3) on the cases similar to the diseases that had been encountered in Phase 1 (those cases subject to an availability bias in Phase 2) are presented Table 4. A significant main effect of "type of reasoning" was found in the ANOVA ($F(1,34) = 8.46$, MSE = .30, $P = 0.006$, $\eta_p^2 = 0.20$), indicating that reflection improved all participants' diagnoses compared to non-analytical reasoning. The percentage of Phase 1 diagnoses that were corrected or adhered to after reflection is shown in Table 3.

4. Discussion

This study demonstrated that an availab

recent experiences with similar clinical cases v

used, yielding diagnostic errors, and that reflec

The results suggest that the occurrence and neg

of the reasoning approach used and the experti

Encountering only one case of a diseas

residents more prone to incorrectly giving that

though similar, diseases. In emergency rooms

see (often close in time) several patients with s

In many clinical settings, therefore, conditions

availability bias prevail.

Appendix A

Example of a medical case

A 27-year-old woman presented with 11-month duration of complaints of diarrhea and flatulence and episodes of abdominal cramps. She has had stools 5-6 times a day, and has often woken up during the night for defecation. The feces are voluminous and soft without mucus, blood, or pus. The abdominal cramps are more severe just before defecation, after which they become less painful. The patient is fatigued and has experienced a 5-kg weight loss over the past 11 months. She also noticed red spots on her skin. She says that she has not had fever or joint pains. The patient consulted a doctor four months ago as well. The doctor prescribed ferrous sulphate for anemia, which she has been using until now. Family history: her father was treated for lung tuberculosis 20 years ago.

Physical examination:

Young, somewhat emaciated woman of otherwise healthy appearance. BP: 110/70; pulse: 80/min; temperature: 36°C. Mucocutaneous paleness (+/4). No other abnormalities.

Lab tests:

Hemoglobin: 9 g/dL; Hematocrit: 34%; MCV: 74 fl; serum iron: 45 mg/dl (normal 50-170); calcium: 8.1 mg/dL (normal 8.6-10); albumin: 3.2 g/dL (3.4-4.8); ALT: 38 U/L; AST: 25 U/L; PT 24 sec (12-22 sec). Feces: no worm eggs, no parasites, no white cells; stool fat level: 12g /24h (<7g/24h), D-Xylose test: positive. HIV antibodies: negative. PPD skin test: 5 mm.

Imaging tests:

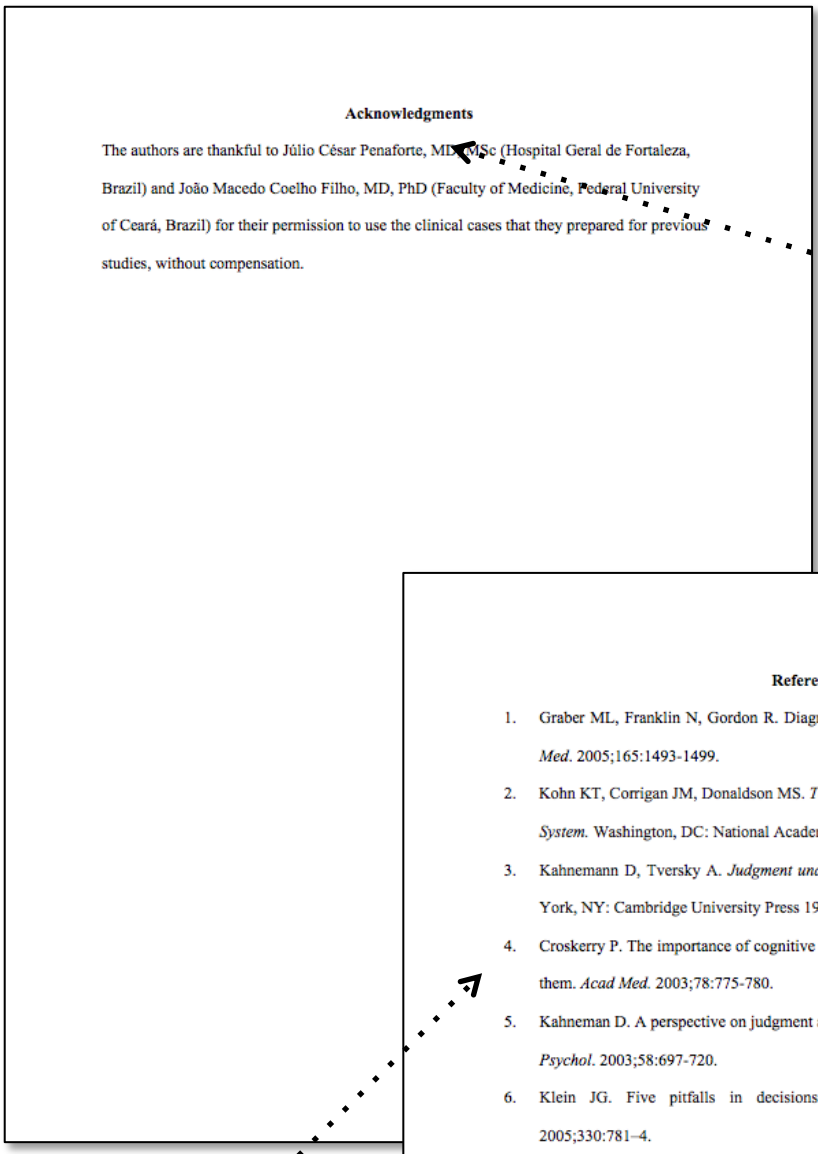
Chest X-ray: no abnormalities; Colonoscopy: no abnormalities.

15

P-value and effect-size (3C)

Discussion section (3D)

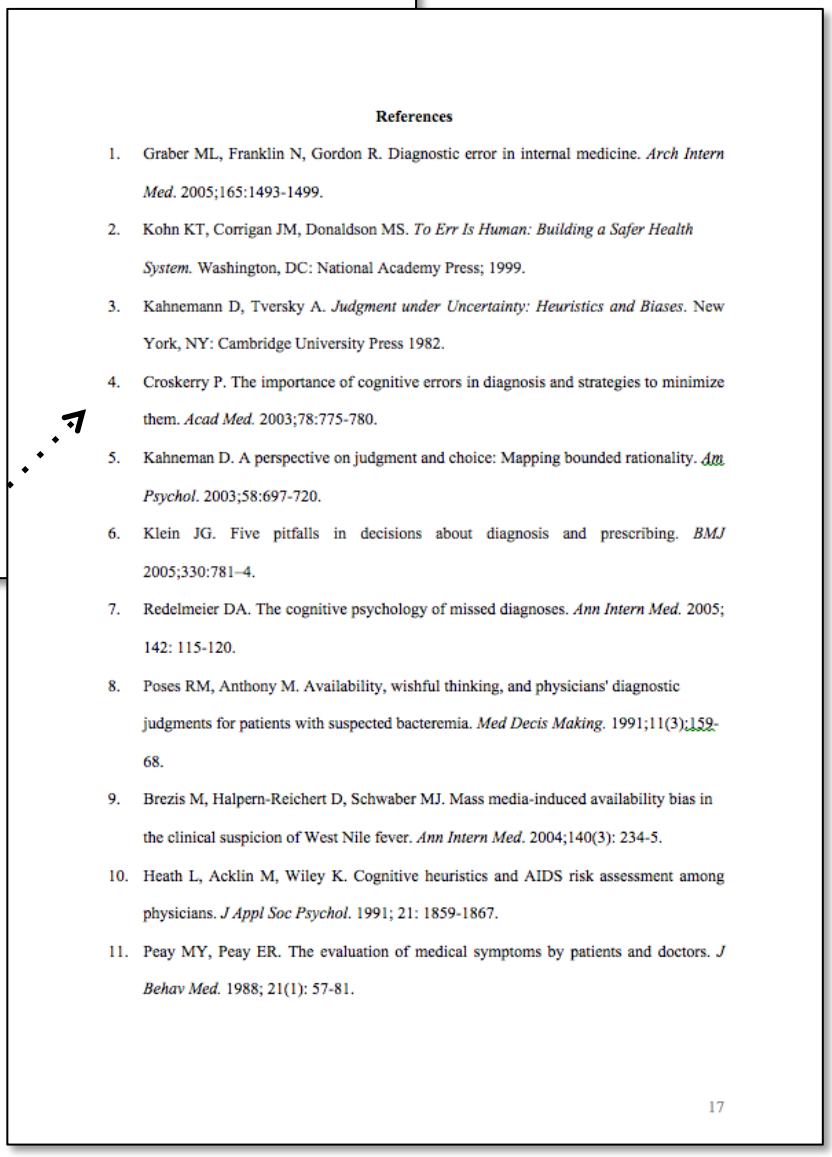
Appendix A if more than one appendix (e.g., B, C, D); if only one appendix, then "Appendix" (4A)



Acknowledgments

The authors are thankful to Júlio César Penaforte, MD, MSc (Hospital Geral de Fortaleza, Brazil) and João Macedo Coelho Filho, MD, PhD (Faculty of Medicine, Federal University of Ceará, Brazil) for their permission to use the clinical cases that they prepared for previous studies, without compensation.

Acknowledgements; Clearly identify persons with name and affiliation (4B)



References

1. Graber ML, Franklin N, Gordon R. Diagnostic error in internal medicine. *Arch Intern Med*. 2005;165:1493-1499.
2. Kohn KT, Corrigan JM, Donaldson MS. *To Err Is Human: Building a Safer Health System.* Washington, DC: National Academy Press; 1999.
3. Kahnemann D, Tversky A. *Judgment under Uncertainty: Heuristics and Biases*. New York, NY: Cambridge University Press 1982.
4. Croskerry P. The importance of cognitive errors in diagnosis and strategies to minimize them. *Acad Med.* 2003;78:775-780.
5. Kahneman D. A perspective on judgment and choice: Mapping bounded rationality. *Am Psychol*. 2003;58:697-720.
6. Klein JG. Five pitfalls in decisions about diagnosis and prescribing. *BMJ* 2005;330:781–4.
7. Redelmeier DA. The cognitive psychology of missed diagnoses. *Ann Intern Med.* 2005; 142: 115-120.
8. Poses RM, Anthony M. Availability, wishful thinking, and physicians' diagnostic judgments for patients with suspected bacteremia. *Med Decis Making.* 1991;11(3):159-68.
9. Brezis M, Halpern-Reichert D, Schwaber MJ. Mass media-induced availability bias in the clinical suspicion of West Nile fever. *Ann Intern Med*. 2004;140(3): 234-5.
10. Heath L, Acklin M, Wiley K. Cognitive heuristics and AIDS risk assessment among physicians. *J Appl Soc Psychol*. 1991; 21: 1859-1867.
11. Peay MY, Peay ER. The evaluation of medical symptoms by patients and doctors. *J Behav Med.* 1988; 21(1): 57-81.

17

References (5E)

Layout of a table (4G)

Tables

Table 1. Clinical cases used in each phase of the study.

	Phase 1 Exposure (diagnosis evaluation task)	Phase 2 Non-analytical diagnostic reasoning	Phase 3 Reflective diagnostic reasoning
Set 1	Case A: Acute viral hepatitis	Cases similar to case A[a] • Liver cirrhosis • Primary sclerosing cholangitis	Cases similar to case A: • Liver cirrhosis • Primary sclerosing cholangitis
	Case B: Inflammatory bowel disease	Cases similar to case B[a] • Celiac Disease • Pseudomembranous colitis	Cases similar to case B: • Celiac Disease • Pseudomembranous colitis
	Neutral case 1: Meningitis Neutral case 2: Pyelonephritis Neutral case 3: Pneumonia Neutral case 4: Hyperthyroidism	Cases similar to case C[b] • Acute viral pericarditis • Aortic dissection	
		Cases similar to case D[b] • Neurosyphilis • Vitamin B12 Deficiency	
Set 2	Case C: Acute myocardial infarction	Cases similar to case C[a] • Acute viral pericarditis • Aor	Cases similar to case C: • Acute viral pericarditis
	Case D: W's Encephalopathy	Cases • Neu • Vit	
	Neutral case 1: Meningitis Neutral case 2: Pyelonephritis Neutral case 3: Pneumonia Neutral case 4: Hyperthyroidism	Cases • Liv • Pri cho	
		Cases • Cel • Psc	

[a] Cases potentially subject to bias

[b] Cases not subject to bias

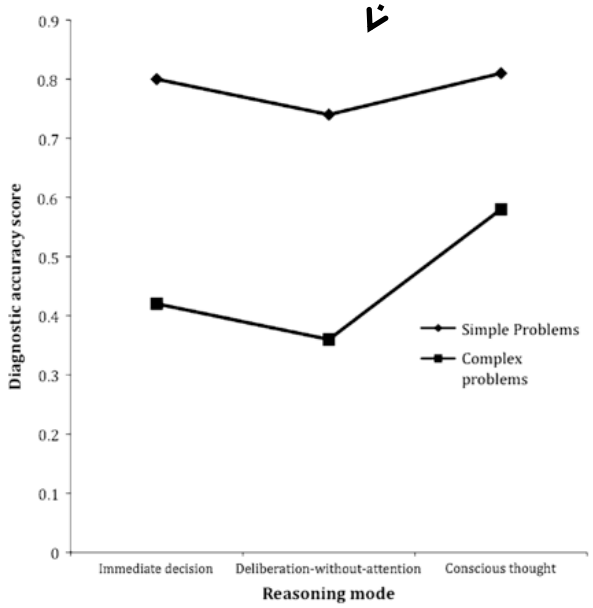
Place footnotes to tables below the table body

Figure with caption (4F)

No gridlines or shading

Figures

Figure 1. First and second year residents' mean diagnostic accuracy scores (range from 0 – 4) in Phase 2 (non-analytical diagnostic reasoning) as a function of previous exposure to similar cases in Phase 1



Both axes must be labelled

21