INTERNATIONAL JOURNAL OF CLINICAL SKILLS

docendo ac discendo

by teaching and by learning

IJOCS
VOLUME 07
ISSUE 03
MAY 2013

A Peer Reviewed International Journal for the Advancement of Clinical Skills

Contents

Foreword

Welcome to the latest edition of the International Journal of Clinical Skills (IJOCS), Volume 7, Issue 3, May 2013.

Working out of hours is associated with heightened levels of fatigue among medical staff, when compared with day work. Professor Aidan Byrne leads a group of researchers to investigate the effect of 'out of hours' working on the mental workload of anaesthetists during routine practice. The study supports the use of mental workload measurement as a technique to measure the effect of changes in the anaesthetic working environment. The technique could be used to provide a method of identifying individuals or periods of high mental workload and to measure the effectiveness of putative risk reduction strategies.

Doctors are often interrupted during the course of their clinical activities and it is likely that such distractions contribute to medication related errors. However, the impact of distraction on an individual's ability to perform drug related calculations has never been formally tested. Our colleagues at Queen's University Belfast, Northern Ireland, investigate cognitive distraction and discuss interesting findings which should be incorporated into every medical curriculum.

Extensive research indicates that adults learn best when they are motivated, self-directed, and can choose what and how they learn. This is especially important for postgraduate continuing professional development. Dr Anita Young and Dr Helen Meldrum of Bentley University, USA, present a study focusing on continuing pharmacy education. This thought-provoking study clearly demonstrates that all stakeholders in pharmacy education need to consider moving forward to revise the underlying structure of the continuing education experience.

As always, your feedback is invaluable for the continued development of the International Journal of Clinical Skills – the only peer reviewed international journal devoted to clinical skills (e-mail: feedback@ijocs.org)

Contents

Executive Board

International Journal Of Clinical Skills
P O BOX 56395
London
SE1 2UZ

info@ijocs.org
www.ijocs.org
Tel: +44 (0) 845 0920 114
Fax: +44 (0) 845 0920 115

Published by Hampton Bond

Editorial Board

Disclaimer & Information

Visit the International Journal of Clinical Skills (IJOCS) at www.ijocs.org
Whilst every effort has been made to ensure the accuracy of information within the IJOCS, no responsibility for damage, loss or injury whatsoever to any person acting or refraining from action as a result of information contained within the IJOCS (all formats), or associated publications (including letters, e-mails, supplements), can be accepted by those involved in its publication, including but not limited to contributors, authors, editors, managers, designers, publishers and illustrators.

Always follow the guidelines issued by the appropriate authorities in the country in which you are practicing and the manufacturers of specific products. Medical knowledge is constantly changing and whilst the authors have ensured that all advice, recipes, formulas, instructions, applications, dosages and practices are based on current indications, there may be specific differences between communities. The IJOCS advises readers to confirm the information, especially with regard to drug usage, with current standards of practice.

International Journal of Clinical Skills (IJOCS) and associated artwork are registered trademarks of the Journal. IJOCS is registered with the British Library, print ISSN 1753-0431 & online ISSN 1753-044X. No part of IJOCS, or its additional publications, may be reproduced or transmitted, in any form or by any means, without permission. The International Journal of Clinical Skills thanks you for your co-operation.

The International Journal of Clinical Skills (IJOCS) is a trading name of SkillsClinic Limited a company registered in England & Wales. Company Registration No. 6310040. VAT Number 912180948. IJOCS abides by the Data Protection Act 1998 Registration Number Z1027439. This Journal is printed on paper as defined by ISO 9706 standard, acid free paper.

'Shush! I am counting!' – The impact of distraction on medical students' ability to perform drug dose calculations

Contributors

Miss Anna Leersson BA
Undergraduate Student in School of Psychology [1]

Dr Judith Wylie BA PhD
Senior Lecturer in School of Psychology [1]

Dr William Scott BSc PhD
Lecturer in School of Nursing and Midwifery [1]

Dr Gerry Gormley MD FRCGP
Senior Clinical Academic General Practitioner [2]

[1] Queen's University Belfast, Belfast, Northern Ireland

[2] Centre for Medical Education, Queen's University Belfast, Belfast, Northern Ireland

Correspondence

Dr Gerry Gormley
Department of General Practice
Queens University Belfast
4th Floor; Dunluce Health Centre
1 Dunluce Avenue
Belfast
BT9 7HR
Northern Ireland

E-mail: g.gormley@qub.ac.uk
Tel: +44 (0) 2890204252
Fax: +44 (0) 2890310202

Keywords

Medical student
Numeracy skills
Drug calculations
Distraction

Abstract

Background:
Doctors are often interrupted during the course of their clinical activities and it is likely that such distractions contribute to medication related errors. However, the impact of distraction on an individual's ability to perform drug related calculations has never been formally tested.

Aim:
This study aims to assess the impact of cognitive distraction on medical student's drug calculation abilities.

Methods:
Medical students were randomised into either an intervention (distraction) or control group. Participant's base line numeracy ability was measured. Both groups were asked to perform a series of drug related calculations. However, in the intervention group a series of 'clinical statements' were read out and participants had to remember these statements whilst performing the drug calculations. The control group performed the same drug calculations, but in a quiet environment.

Results:
Those participants who were distracted had a significantly lower score in the drug calculation test ($P < 0.005$). Objectively measuring participant's numeracy ability correlated with their performance in the drug calculation test for both the distraction ($P < 0.01$) and control groups ($P = 0.001$).

Conclusion:
Cognitive distraction appears to have a negative impact on medical student's ability to perform drug related calculations. Non-technical skill training, such as dealing with interruptions, should be an integral part of the medical curriculum.

Introduction

Accurate and safe prescribing is a fundamental skill for all practicing clinical doctors. However, medication errors are recognised as a common cause of adverse drug events and have the potential to result in significant patient morbidity and mortality [1 – 4]. Errors in drug-dose calculations are one of the many steps that can contribute to such adverse drug events occurring [5]. Even in a relatively quiet testing environment it has been shown that many healthcare professionals are challenged in accurately carrying out such drug-dose related calculations [6, 7].

When performing such calculations in the workplace, healthcare professionals encounter many distractions and interruptions [8, 9, 10]. Such disruptions can arise from various sources including work colleagues, patients and their relatives [11]. It is likely that disturbances are one of the many contributory factors to drug calculation errors [12, 13].

Environmental strategies have been developed that aim to reduce such distractions occurring during the preparation and administration of medication in the workplace. For example, nursing staff may wear a tabard with signage discouraging interruptions while carrying out drug-related activities [14, 15]. Junior doctors frequently perform drug calculations and prescribe in the workplace. A large proportion of these doctors are known to have made mistakes in their prescribing and are less likely to avail of such organisational strategies to minimise any interruptions during medication-related activities [16, 17].

Developing competency in prescribing, and measures in preventing errors in prescribing, are of vital importance and should start at an undergraduate level. However, it has been acknowledged that graduates often feel insufficiently prepared to prescribe safely [16, 18]. The aim of this study is to assess the impact of cognitive distraction on medical students' ability to perform drug-related calculations.

Methods

Fourth year medical students at Queen's University Belfast were invited to participate in the study. At the beginning of the academic year students were randomly allocated to one of six teaching groups. Two of these groups were approached (December 2011) to take part in the study (n = 36+37). One of these cohorts was randomly selected to be an intervention (distraction) group and the other a control group.

Consenting students completed an anonymised questionnaire to ascertain their age and sex. Participants were asked to indicate their numeracy ability on a 10cm visual analogue scale (ranging from 0 = poor to 10 = outstanding). Their numeracy ability was also measured using a psychometric test [19]. In this test, participants were presented with a series of questions that assessed a range of numeracy skills including calculation, algebraic reasoning, graphical interpretation, proportionality, ratio and estimation. Participants were asked to complete the numeracy test within 30 minutes. The maximum potential score was 32 and the minimum 0.

Following this, participants were asked to complete a drug calculation test. This test comprised 7 drug dose calculations, all of which were published in previous studies and deemed by faculty to be at an appropriate academic ability for fourth year medical students [6, 20]. The maximum potential score was 7 and the minimum 0. Participants were instructed to attempt all questions within a 14 minute time limit.

The control group completed this drug calculation test in a quiet environment without any distraction. The distraction group completed the same drug test in an environment with distractors. The distractors took the form of a series of 14 verbal statements typical of interruptions encountered in a clinical ward situation (e.g. *"Mr Moore's daughter is on the telephone asking about an update on his condition").* Participants in the distraction group were informed that while carrying out the drug-related calculations, they also had to listen to the statements and that they would be asked questions about these statements following completion of the drug calculation test. Participants were not allowed to make any notes relating to the distractor statements. The subsequent questions were posed in the same order as the verbal distractor statements had been presented. Participants entered their responses to these questions on a separate sheet. At no stage during the study were participants allowed to use a calculator.

This study received ethical approval by the School of Medicines Ethics committee, Queen's University Belfast, Northern Ireland.

Analysis

Correlations were used to investigate the relationship between scores on the drug calculation test, the baseline numeracy measure and self-rated numeracy ability. Analysis of variance was used to examine differences in the drug calculation scores between males and females, and between the distraction and control groups. The similarity of the distraction and control groups in terms of age and sex was investigated using chi-square analysis.

Results

Performance in the numeracy test

64 out of 73 students agreed to participate in the study. The age (modal age group = 20 – 22 years) and sex (male = 26/64, 40.6%; female = 38/64, 59.4%) of participants were in keeping with the total year group (mean age = 21.5 years; male = 101/249, 40.6%; female = 148/249, 59.4%). There were 30 participants in the distraction group and 34 in the control group (Table 1). There were no significant differences between the two groups in terms of age ($\chi 2(1, N = 64) = 2.76$, $P = 0.25$) or sex (χ 2(1, N = 64) = 0.68, P = 0.80).

Table 1: Characteristics of participants in the control and distraction groups

Sex	Control Group	Distraction Group
Male (%)	13/34 (38.2)	13/30 (43.3)
Female (%)	21/34 (61.8)	17/30 (56.7)
Mean age (years) (range)	21.8 (20 – 31)	21.2 (20 – 25)
Perceived numeracy ability (cm)*	5.6	6.7
Mean numeracy test score (SD) #	21.9 (3.5)	18.7 (5.1)

** As measured on a 10cm visual analogue scale (ranging 0 = poor to 10 = outstanding)*
 # Numeracy test score as measured on their performance in the Mulhern and Wylie numeracy test (Scores ranging from a potential minimum 0 to a maximum 32)

Drug calculation test performance

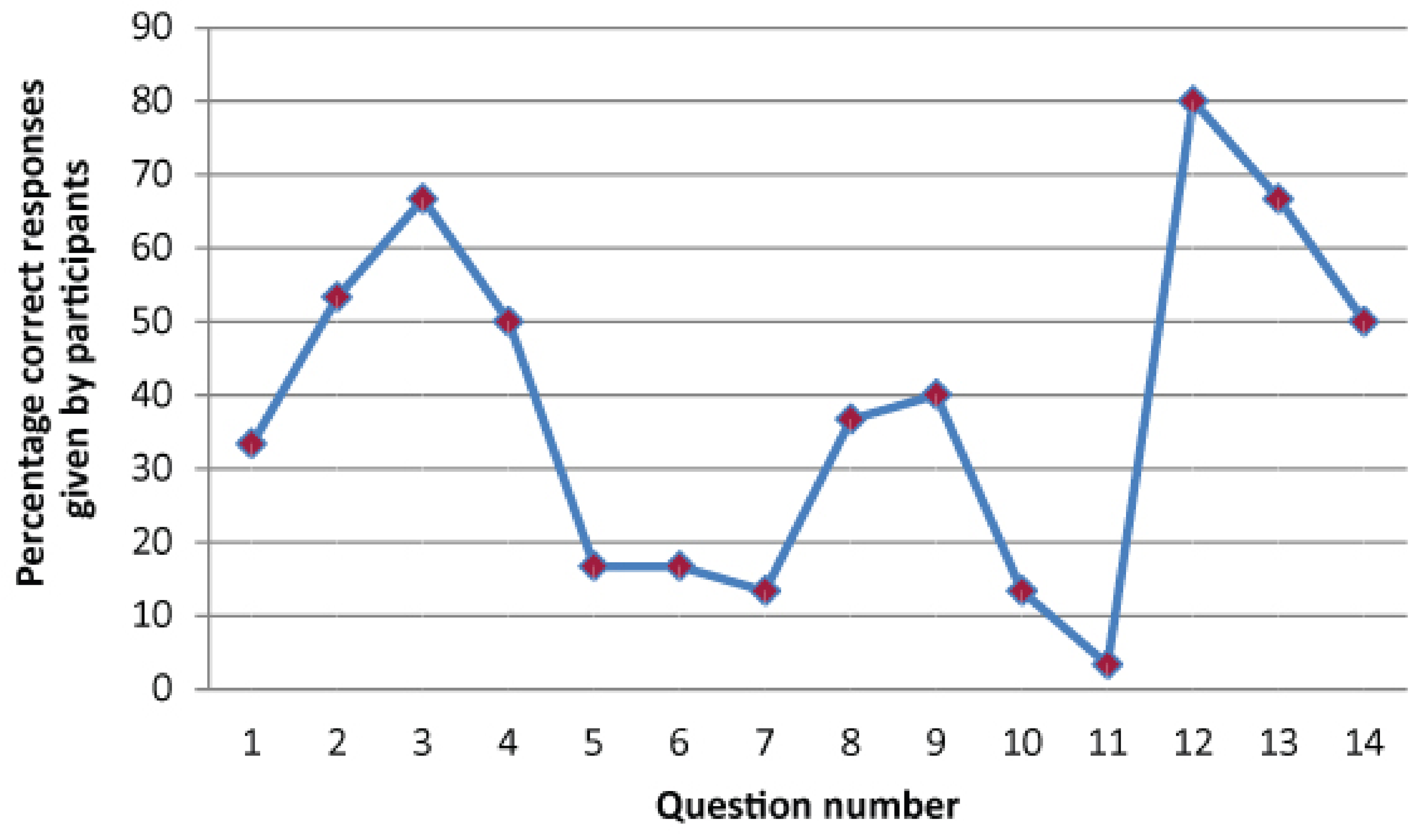
Drug calculation test scores ranged from 1 to 6 (mean = 3.53; SD = 1.25) in the distraction group and from 2 to 7 (mean = 4.42; SD = 1.18) in the control group. A 2 (condition) x 2 (gender) between groups anova revealed a main effect of condition on drug calculation test score ($F(1,60) = 8.88$, $P < 0.005$), with participants in the distraction group scoring more poorly than those in the control group. There was no main effect of gender, and no group by gender interaction. Self-rated numeracy ability and performance in the drug calculation test correlated for the distraction group ($r(28) = 0.51$, $P < 0.005$) but not for the control group. Numeracy test scores and drug calculation test scores correlated significantly for the distraction ($r(28) = 0.47$, $P < 0.01$) and control groups (r(32 = 0.53, P = 0.001).

Distraction

The mean number of correct responses to the distractor statements was 5.4/14 (SD = 2.13). Figure 1 displays mean correct responses for each of the 14 distractor questions.

There was no correlation between drug calculation scores and the number of correctly answered distractor questions ($r(28) = -0.057$, $P = 0.765$), and no significant sex difference was detected on distractor question scores ($t(28) = -7.21$, $P = 0.477$)

Figure 1: Percentage correct responses to each of the distractor questions



Discussion

The findings of this study suggest that cognitive distraction has a negative impact on medical students' ability to accurately perform drug-dose-related calculations. Participants' memory for the distracting information was relatively poor too, which suggests that students struggled with processing unrelated information while engaged in calculation. Overall, those students who perceived themselves as having better numeracy ability did not perform better when carrying out drug-dose calculations. However, their objectively measured numeracy ability correlated with their performance in carrying out drug-dose calculations, whether being distracted or not.

One of the most widely accepted models of memory and attentional processes is the multicomponent model of working memory [21, 22]. It is largely agreed that working memory is used in tasks that require integration of new stimuli with long-term memory, and the maintenance of information for complex tasks such as problem solving and reasoning. Importantly, working memory is considered to be of limited capacity. Mental arithmetic can be assumed to be a demanding task for the working memory system [23]. In a situation where an individual is required to divide their attention between performing a mentally demanding task and responding to external stimuli, it is not surprising that they might struggle to successfully complete both tasks, particularly when the secondary task is also taxing to the working memory system.

Results from our study would indicate that distraction has a detrimental impact on medical students' ability to accurately perform drug calculations. However, we are unable to determine if such distractions contribute solely to adverse drug events occurring in practice. Causes for medication errors are often multifactorial and interventions to individual problems are less likely to make a positive impact [16].

However, defining and addressing any potential contributory sources of error are to be welcomed. Providing solutions to such error-provoking conditions, such as distraction, are of importance in the overall aim of minimising adverse drug events.

Competency in prescribing is a complex, socially positioned skill [16]. Prescribers are required to apply their knowledge of medications in the clinical environment and react to the many different contextual stimuli and features that are invariably present in such busy workplaces. Therefore developing expertise in prescribing requires educational endeavours that link prescribing theory to practical knowledge and performance. Such educational frameworks need to consider issues that relate to the prescriber, the environment they work in and the complex interplay between them [16].

From an educational perspective, development of competency in prescribing should be an ongoing and contextual process across the undergraduate-postgraduate continuum. In undergraduate medical degree programmes greater emphasis should be placed on generic skills such as numeracy. Findings from our study would suggest that students' self-assessment of their numeracy ability did not correlate with their ability to accurately complete a drug-dose calculation test. However, our findings indicated that performance in a drug calculation test did correlate with objectively measured numeracy ability. It is known that assessment of one's own abilities is challenging and often inaccurate [24]. Feedback on performance provides useful information for an individual to make a more accurate assessment of one's own ability [25]. It could, therefore, be argued that medical students should have formal numeracy testing, with remedial work provided for individuals who are more challenged by numeracy related tasks.

Consideration should also be given to developing students' coping strategies in dealing with the many non-technical issues that they may encounter in the workplace such as distraction and interruptions. Interprofessional-based educational programmes have an important role to play in emphasising the use of effective of communication skills between healthcare professionals, and the potential impact that interruptions can have on an individual's performance. Modifications to workplace environmental and organisational factors also have the potential to mitigate the risk between interruptions and medication-related errors. Even simply having designated quiet areas on the ward for staff to perform drug-related activities should be considered.

The findings of this study have to be considered within its limitations. In order to control for confounding factors the study was not carried out in an ecologically valid setting. Though cognitive distraction was found to have negatively affected participant's ability to correctly perform drug calculations, the effect was small. This may be due to the small number of drug calculations presented to participants, although the amount of questions used in this study were in keeping with other similar studies [6, 20]. The secondary task (answering questions relating to the statements that were called out during the drug calculation test) – was generally performed poorly by all participants. Nevertheless, primacy and recency effects (i.e. peaks in recall for items at the start and the end of a series of items) were found, which suggests that participants were attending fully to the secondary task as well as the primary task (i.e. performing the drug calculations). This study was carried out on a sample of students from one cohort. Though participants' characteristics in this study were comparable to the total year group, the results may not be truly generalizable to other medical schools.

Further research is required to help clarify if the same effect is present in practicing doctors and other healthcare professionals. Furthermore, it would be important to measure the effect of fatigue on healthcare professional ability to accurately perform drug dose calculations and other medication related activities.

In summary, competent prescribing is a complex contextual skill. Multifaceted and strategic approaches are required in order to reduce medication related errors and adverse drug events occurring. From an educational perspective, a greater emphasis is required in linking theory and application of knowledge in clinical practice. Non-technical issues, such as distraction, have the potential to impair an individual's ability to accurately and safely prescribe. Training, starting at an undergraduate level, needs to make students mindful of the potential impact such distractions may have on their ability to prescribe safely. Their learning should also equip them with coping strategies to mitigate such error provoking situations and adverse drug events occurring.

Declarations

This project received no external funding and requires no declarations.

The authors have no financial or other interests to declare in relation to this paper.

Acknowledgements

The authors of this study would like to thank all those students who participated in this research.

References

1. Aspden P, Wolcott J, Bootman J L, Cronenwett L R. (2007). Institute of Medicine. Committee on Identifying and Preventing Medication Errors. Preventing Medication Errors. Washington DC, National Academies Press.

2. Lewis P J, Dornan T, Taylor D, Tully M P, Wass V, Ashcroft D M. (2009). Prevalence, incidence and nature of prescribing errors in hospital inpatients: a systematic review. Drug Safety. 32(5):379-389.

3. National Patient Safety Agency. (2009). Safety in doses. London: National Patient Safety Agency.

4. Schachter M. (2009). The epidemiology of medication errors: how many, how serious? British Journal of Clinical Pharmacology. 67(6):621-623.

5. Schachter M. (2012). Common prescribing errors and how to prevent them. Medicine. 40(7):394-396. Available at http://www.sciencedirect.com/science/article/pii/S1357303912001144 [Accessed March 2014].

6. Oldridge G J, Gray K M, McDermott L M, Kirkpatrick C M. (2004). Pilot study to determine the ability of health-care professionals to undertake drug dose calculations. Internal Medicine Journal. 34(6):316-319.

7. Rolfe S, Harper N J. (1995). Ability of hospital doctors to calculate drug doses. BMJ. 310(6988):1173-1174.

8. Relihan E, O'Brien V, O'Hara S, Silke B. (2010). The impact of a set of interventions to reduce interruptions and distractions to nurses during medication administration. Quality & Safety in Health Care. 19(5):e52.

9. Alvarez G, Coiera E. (2005) Interruptive communication patterns in the intensive care unit ward round. International Journal of Medical Informatics. 74(10):791-796.

10. Chisholm C D, Collison E K, Nelson D R, Cordell W H. (2000). Emergency department workplace interruptions: are emergency physicians "interrupt-driven" and "multitasking"? Academic Emergency Medicine. 7(11):1239-1243.

11. Palese A, Sartor A, Costaperaria G, Bresadola V. (2009). Interruptions during nurses' drug rounds in surgical wards: observational study. Journal of Nursing Management. 17(2):185-192.

12. Tully M P, Ashcroft D M, Dornan T, Lewis P J, Taylor D, Wass V. (2009). The causes of and factors associated with prescribing errors in hospital inpatients. a systematic review. Drug Safety. 32(10):819-836.

13. Hughes R G, Ortiz. (2005). Medication errors: why they happen, and how they can be prevented. The American Journal of Nursing. 105(3 Suppl):14-24.

14. Pape T M, Guerra D M, Muzquiz M, Bryant J B, Ingram M, Schranner B, Alcala A, Sharp J, Bishop D, Carreno E, Welker J. (2005). Innovate approaches to reducing nurses' distractions during medication administration. The Journal of Continuing Education in Nursing. 36(3):108-116.

15. Geller E S. (2000). The Psychology of Safety Handbook. Boca Raton FL, Lewis Publication.

16. Dornan T, Ashcroft D, Heathfield H, Lewis P, Miles J, Taylor D, Tully M, Wass V. (2009). An in depth investigation into causes of prescribing errors by foundation trainees in relation to their medical education – EQUIP study. London: General Medical Council. Available at http://www.gmc-uk.org/about/research/research_commissioned_4.asp [Accessed April 2014].

17. Pirmohamed M, James S, Meakin S, Green C, Scott A K, Walley T J, Farrar K, Park B K, Breckenridge A M. (2004). Adverse drug reactions as cause of admission to hospital: prospective analysis of 18 820 patients. BMJ. 329(7456):15-19.

18. Wall D, Bolshaw A, Carolan J. (2006). From undergraduate medical education to pre-registration house officer year: how prepared are students? Medical Teacher. 28(5):435-439.

19. Mulhern G, Wylie J. (2004). Changing levels of numeracy and other core mathematical skills among psychology undergraduates between 1992 and 2002. British Journal of Psychology. 95(Pt 3):355-370.

20. Rowe C, Koren T, Koren G. (1998). Errors by paediatric residents in calculating drug doses. Archives of Disease in Childhood. 79(1):56-58.

21. Baddeley A. (2010). Working Memory. Current Biology. 20(4):R136-R140.

22. Baddeley A, Hitch G. (1974).Working memory. In Bower G H (Editor), The psychology of learning and motivation: Advances in research and theory, Volume 8, pages 47-89). New York, Academic Press.

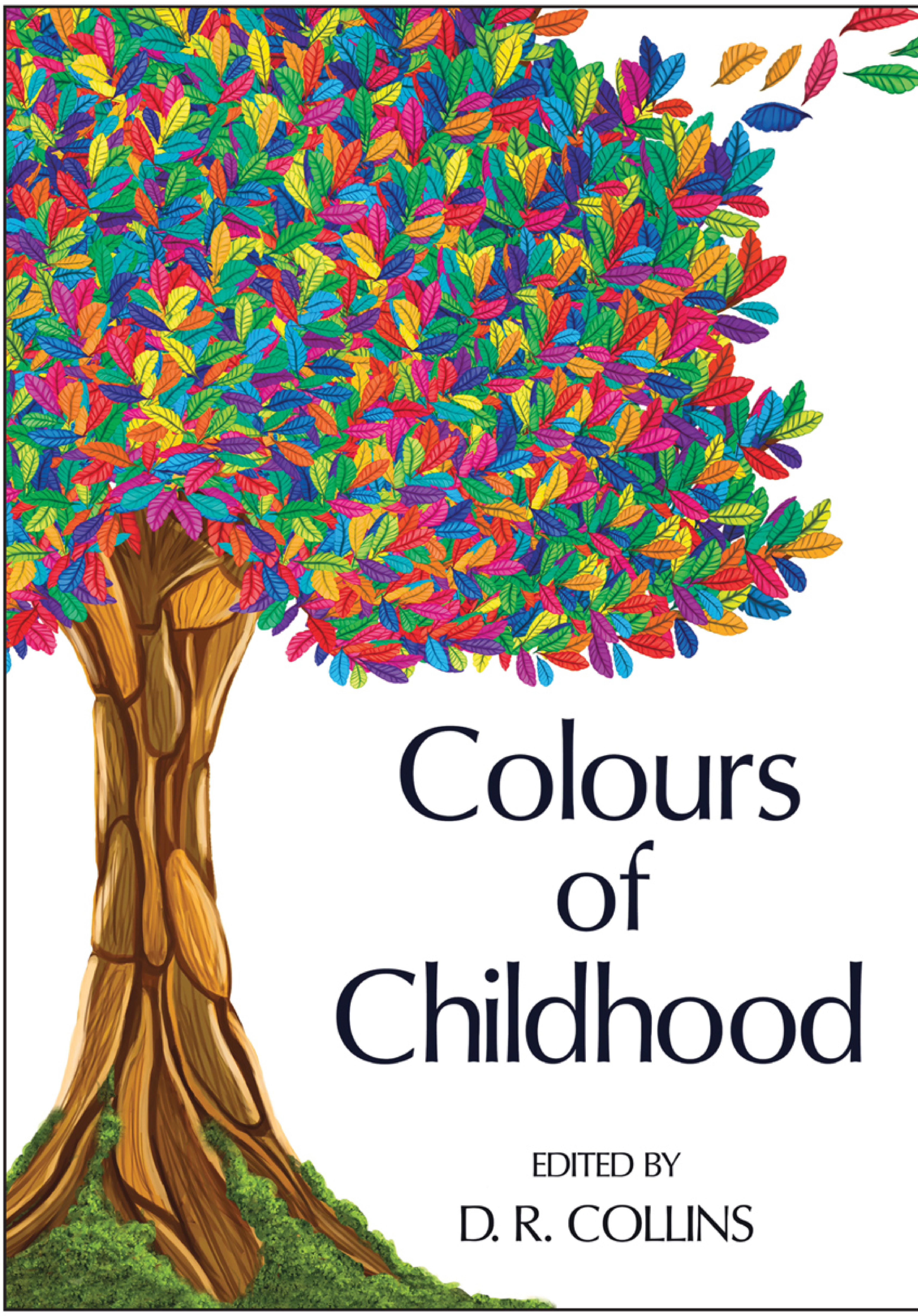
23. Ashcraft M H. (1992). Cognitive arithmetic: a review of data and theory. Cognition. 44(1-2):75-106.

24. Shen C, Pedulla J J. (2000). The relationship between students' achievement and their self-perception of competence and rigour of mathematics and science: a cross-national analysis. Assessment in Education. 7(2):237-253. Available at http://www.tandfonline.com/doi/abs/10.1080/713613335#.U2Y5p4FdWa8 [Accessed Dec 2013].

25. Nicol D J, Macfarlane-Dick D. (2006). Formative assessment and self-regulated learning: a model and seven principles of good feedback practice. Studies in Higher Education. 31(2):199-218. Available at http://www.tandfonline.com/doi/abs/10.1080/03075070600572090#.U2Y6soFdWa8 [Accessed Dec 2013].

CELEBRATING THE UNIQUE VALUE OF EVERY CHILD

Our collective attitudes and actions can change the life of a child forever



AVAILABLE IN ALL GOOD BOOKSHOPS

Published by Hampton Bond International • www.hamptonbond.com • orders@hamptonbond.com


Julie Walters


Ian McKellen


David Jason


Amanda Holden


Dawn French

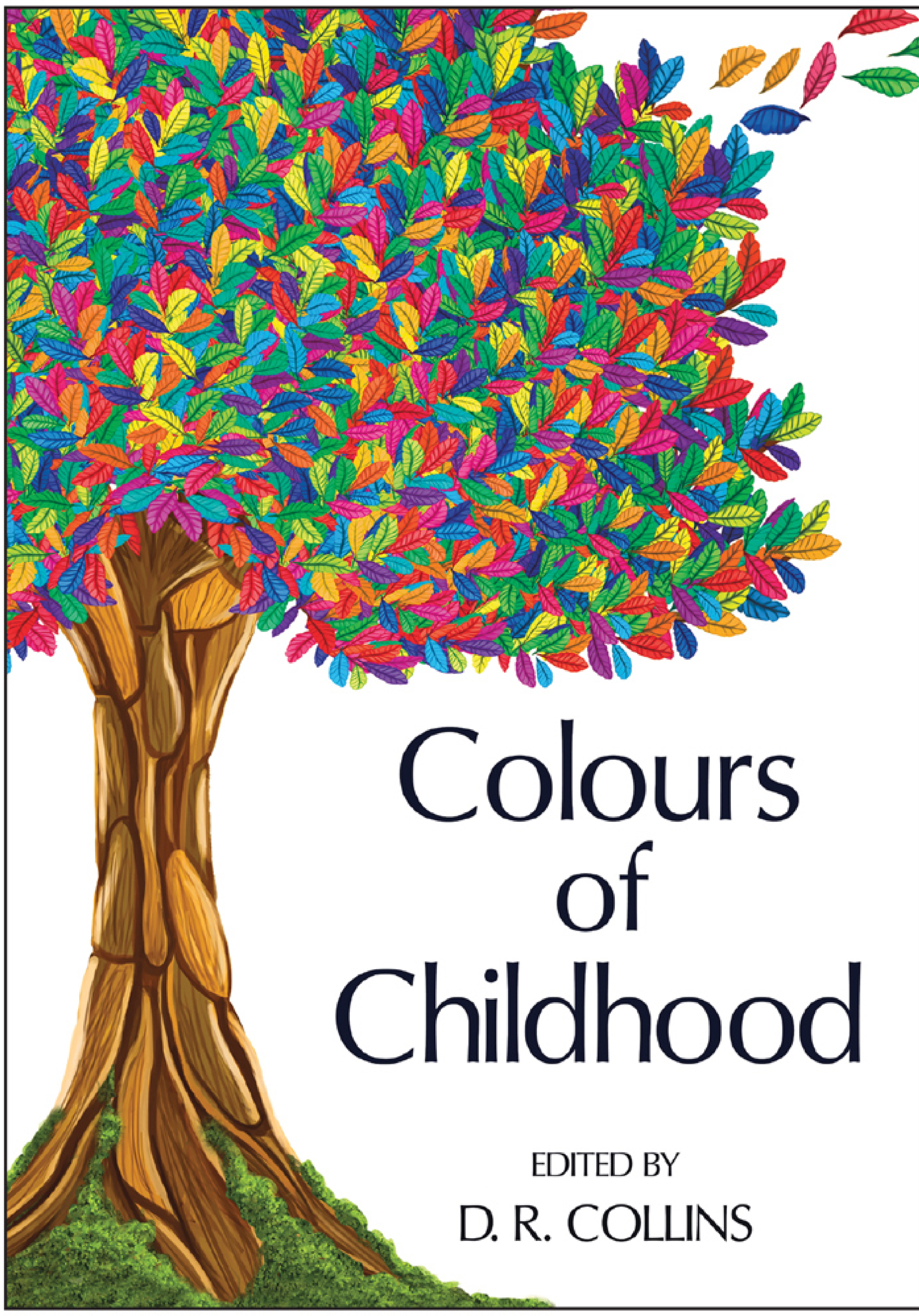

Alex Ferguson

AN ANTHOLOGY OF OVER 200 POEMS AND CELEBRITY CONTRIBUTIONS

www.coloursofchildhood.com

EXCITING NEW RELEASE

Celebrating the unique value of every child



www.coloursofchildhood.com • International Release Date: 01 October 2014

ISBN 9781909555600 (Trade Paperback) • 240 pages • £14.99 RRP

Gary Lineker

'Many years ago, I read some words which made a lasting impression on me - "We make a living by what we get, but we make a life by what we give."'

Jeremy Paxman

'We have become so accustomed to astonishing advances in medicine that it takes a case in the developing world to make us realise how lucky we are.'

Glenn Hoddle

'To help yourself is one thing, to help someone else is the greatest thing we can achieve.'

Jill Dawson

'What comes from the heart reaches the heart.'

Joanna Trollope

'Unkind and unimaginative though it is, this difficult world is easier to negotiate if one is born looking at least acceptable, to other people.'

David Dimbleby

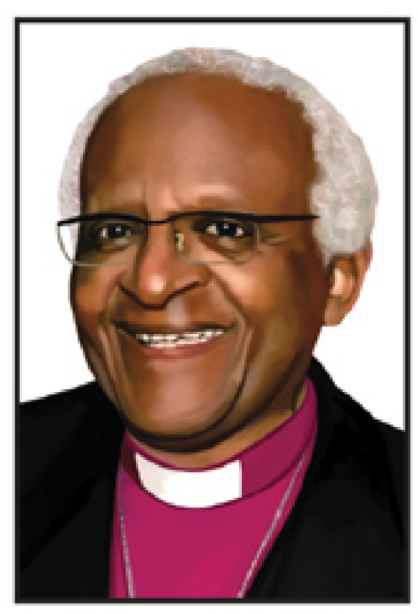
'It is the individual stories that matter - each child helped is a triumph in a world beset by poverty and illness for so many.'

Pope Benedict XVI

Richard E. Grant

Alan Titchmarsh

Jo Brand



Desmond Tutu

Frederick Forsyth

Michael Parkinson

We all have hopes and dreams, many of these in childhood. But life's twists and turns can make or break a future. **Colours of Childhood** is a tribute to childhood and its many colours. It includes contributions from over one hundred people from all walks of life; they include religious leaders, royalty, sporting personalities, actors, politicians and musicians, just to name a few. Over a hundred poems accompany the contributors' messages, with each poem giving a distinctive insight into childhood and much more. The full-page colour illustrations throughout the book provide a thought-provoking background to the poems. Childhood should be a time to be carefree and happy – but not all of us are so lucky. This unique anthology depicts also human determination and courage, as well as the urge to love and help others. It gives us hope for a better, more united world. What were your childhood hopes and dreams? Wherever life leads you, **Colours of Childhood** is sure to inspire you and brighten your way.

EVERY SALE OF THIS BOOK WILL HELP THE UK CHARITY WILLING AND ABEL

(REGISTERED IN ENGLAND, CHARITY NUMBER 1130492)

www.willingandabel.org.uk

Published by Hampton Bond International • www.hamptonbond.com

Order via Nielsen BookNet or e-mail orders@hamptonbond.com