

**Eye Tracking for the  
Chemistry Education Researcher**



### Library of Congress Cataloging-in-Publication Data

Names: VandenPlas, Jessica R., editor. | Hansen, Sarah J. R., editor. | Cullipher, Steven, editor. | American Chemical Society. Division of Chemical Education.

Title: Eye tracking for the chemistry education researcher / Jessica R.

VandenPlas, editor (Department of Chemistry, Grand Valley State University, Allendale, Michigan), Sarah J.R. Hansen, editor (Department of Chemistry, Columbia University, New York, New York), Steven Cullipher, editor (Science and Mathematics Department, Massachusetts Maritime Academy, Buzzards Bay, Massachusetts) ; sponsored by the ACS Division of Chemical Education.

Description: Washington, DC : American Chemical Society, [2018] | Series: ACS symposium series ; 1292 | Includes bibliographical references and index.

Identifiers: LCCN 2018038283 (print) | LCCN 2018041332 (ebook) | ISBN 9780841233409 (ebook) | ISBN 9780841233423 (hardcover OP) | ISBN 9781713889311 (pod)

Subjects: LCSH: Chemistry--Study and teaching--Research. | Eye tracking. | Tracking (Engineering)

Classification: LCC QD40 (ebook) | LCC QD40 .E94 2018 (print) | DDC 540.71--dc23

LC record available at <https://lcn.loc.gov/2018038283>

The paper used in this publication meets the minimum requirements of American National Standard for Information Sciences—Permanence of Paper for Printed Library Materials, ANSI Z39.48-1984.

Copyright © 2018 American Chemical Society

Distributed in print by Oxford University Press

All Rights Reserved. Reprographic copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Act is allowed for internal use only, provided that a per-chapter fee of \$40.25 plus \$0.75 per page is paid to the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, USA. Republication or reproduction for sale of pages in this book is permitted only under license from ACS. Direct these and other permission requests to ACS Copyright Office, Publications Division, 1155 16th Street, N.W., Washington, DC 20036.

The citation of trade names and/or names of manufacturers in this publication is not to be construed as an endorsement or as approval by ACS of the commercial products or services referenced herein; nor should the mere reference herein to any drawing, specification, chemical process, or other data be regarded as a license or as a conveyance of any right or permission to the holder, reader, or any other person or corporation, to manufacture, reproduce, use, or sell any patented invention or copyrighted work that may in any way be related thereto. Registered names, trademarks, etc., used in this publication, even without specific indication thereof, are not to be considered unprotected by law.

PRINTED IN THE UNITED STATES OF AMERICA

# Contents

<b>Preface .....</b>	<b>ix</b>
<b>1. Eye Tracking as a Research Tool: An Introduction .....</b>	<b>1</b>
Steven Cullipher, Sarah J. R. Hansen, and Jessica R. VandenPlas	
<b>2. Eye Tracking in Chemistry Education Research: Study Logistics .....</b>	<b>11</b>
Sarah J. R. Hansen and Jessica R. VandenPlas	
<b>3. What They See Impacts the Data You Get: Selection and Design of Visual Stimuli .....</b>	<b>25</b>
Katherine L. Havanki and Sarah J. R. Hansen	
<b>4. Using Fixations To Measure Attention .....</b>	<b>53</b>
Steven Cullipher and Jessica R. VandenPlas	
<b>5. Sequence Analysis: Use of Scanpath Patterns for Analysis of Students' Problem-Solving Strategies .....</b>	<b>73</b>
Elizabeth L. Day, Hui Tang, Lisa K. Kendhammer, and Norbert J. Pienta	
<b>6. Advanced Methods for Processing and Analyzing Eye-Tracking Data Using R .....</b>	<b>99</b>
Hui Tang and Norbert J. Pienta	
<b>7. Using Multiple Psychophysiological Techniques To Triangulate the Results of Eye-Tracking Data .....</b>	<b>119</b>
Kimberly Linenberger Cortes, Kimberly Kammerdiener, and Adriane Randolph	
<b>8. Beyond Gaze Data: Pupillometry as an Additional Data Source in Eye Tracking .....</b>	<b>145</b>
Jessica M. Karch	
<b>9. Coupling Eye Tracking with Verbal Articulation in the Evaluation of Assessment Materials Containing Visual Representations .....</b>	<b>165</b>
Jessica J. Reed, David G. Schreurs, Jeffrey R. Raker, and Kristen L. Murphy	
<b>10. Studying the Language of Organic Chemistry: Visual Processing and Practical Considerations for Eye-Tracking Research in Structural Notation .....</b>	<b>183</b>
Katherine L. Havanki	
<b>Editors' Biographies .....</b>	<b>205</b>

## Indexes

Author Index .....	209
Subject Index .....	211