

# **Discrepancies in Texts and Source Evaluation**

An Investigation Into How Textual, Format and Individual Factors, Affect Use of Sourcing  
Strategies

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## Abstract

Digital reading has become prevalent in private lives, at work and in educational institutions. Accessing and constructing meaning from resources on the internet, often involves reading multiple documents as opposed to single documents. Multiple document reading, requires specific skills and strategies, extending those required in single text reading comprehension. Source evaluation and content integration, both within and across texts, are involved in what is sometimes referred to as the new literacies. Using source information in the meaning making process of reading texts, is in the literature referred to as sourcing. It is particularly relevant when reading two or more documents. Sourcing comprises strategic reading behaviors, that are involved when readers use and evaluate available source information, such as author's credentials, publication venue, date of publication and level of source trustworthiness. The overarching aim of this dissertation is investigating textual format and individual factors that affect use of sourcing. We operationalized sourcing as memory for source to content links.

In study I (N = 86) we investigated the contribution of memory for conflicting information in texts on memory for source to content links. Results showed that memory for source to content links uniquely predicts sourcing, when controlling for gender, prior knowledge, interest and critical reading strategies.

In study II (N = 140) we further examined variables predicting memory for source to content links. Like in study I, the contribution of sourcing to memory for conflicting information, read in texts, was a main focus. We also investigated the indirect and/or direct contribution of presentation format, distributing either separate documents or documents presented on a single paper, based on a between participant study design. In addition, we investigated indirect and/or direct contribution of the individual differences of gender, prior knowledge and interest. Results showed a direct effect of memory for conflicting information on sourcing. Results also showed the direct effect of presentation format on memory for source to content links. In addition, there was a direct effect of gender, in that girls outperformed boys. Participants with higher prior knowledge outperformed those with lower levels of prior knowledge, on source performing tasks. Presentation format and prior knowledge had indirect effects on sourcing, mediated by memory for conflicts in texts.

In the two former studies participants worked with printed material. In study III (N = 85) we made a mock-up digital platform, mimicking a popular scientific site. Like in the two former

studies, the effect of memory for conflicts in text, on sourcing, was of main interest. We investigated if embedded hyperlinks, in a currently read document, that lead to an opposing claim in another document, facilitated memory for source to content links. We also investigated whether prompting conditions encouraged participants' clicking on hyperlinks. Results showed that the number of times participants clicked, positively correlated with memory for linked claims, but not with items that were not linked. A mediational analysis showed an indirect effect of clicking on linked claims on sourcing, with conflict detection as mediating variable.

This dissertation has theoretical as well as practical pedagogical implications. It strengthens and confirms, assumptions derived from significant models, re-framing research done within the domain of the new literacies. By disentangling some of the textual, format and individual factors, that affect use of sourcing strategies, our research informs teaching practices in a complex multi-textual reading society.

## Papers I - III

### Paper I

Stang Lund, E., Bråten, I., Brante, E. W., & Strømsø, H. I. (2017). Memory for textual conflicts predicts sourcing when adolescents read multiple expository texts. *Reading Psychology, 38*, 417-437.

### Paper II

Stang Lund, E., Bråten, I., Brandmo, C., Brante, E., & Strømsø, H. I. (2019). Direct and indirect effects of textual and individual factors on source-content integration when reading about a socio-scientific issue. *Reading and Writing, 32*, 335-356.

### Paper III

Delgado, P., Stang Lund, E., Salmerón, L., & Bråten, I. (in press). To click or not to click: Investigating conflict detection and sourcing in a multiple document hypertext environment. *Reading and Writing*. Advance online publication, <https://doi.org/10.1007/s11145-020-10030-8>.





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## **1. Introduction**

### **1.1 Background**

Modern societies are increasingly relying on highly skilled workers. Most professional routes in western societies involve digital literacy competencies, although in varying degrees. In addition, the complex structures of globalized nations demand that citizens have digital literacy competencies, if they want to make informed and competent choices in their private lives, as well as participating in democratic processes. Parallel to the increasing complexities of the world around us, our reading environments have rapidly changed in complexities, due to the emergence of the internet. While the affluence of the digital modern information society comes with huge advantages and possibilities for readers, there are also new challenges. Modern readers are expected to access useful information from the plethora of documents found online (Flanagin & Metzger, 2008). Only a few decades ago, gatekeepers often stood between information resources and the average reader (Leu, Kinzer, Coiro, Castek, & Henry, 2013). It can be assumed that in many instances teachers, professors, newspaper editors and clergy recommended and filtered reading material, and that readers trusted these agents to provide coherent and relevant information. Today's readers have, to a large degree, taken over the responsibilities of the authorities that traditionally shaped reading. Modern, digital reading often means reading and making sense of a set of documents instead of reading single texts. This is called multiple document (MD) reading. MD reading requires problem solving skills that can be deemed as more sophisticated than those needed when reading single documents. In addition, successful MD reading means using additional strategies to those required when reading single texts (Afflerbach & Cho, 2009).

In a 21<sup>th</sup> century reading environment modern readers are faced with a series of challenges. They have to decide whether or not the information they access is useful for their purpose. Usefulness can, for example, be defined in terms of relevance and trustworthiness. In addition, MD reading often means reading a set of documents that are difficult to transform into coherent and cohesive representations (e.g. Britt, Rouet, & Braasch, 2013). For example, when there are contradictions across a set of documents these differences have to be reconciled (e.g., Braasch, Rouet, Vibert, & Britt, 2012). Information about author expertise, date of publishing, publishing venue, author's agenda and level of benevolence are important information to consider, both when selecting documents and making sense of their content. In other words, paying attention to source information or metadata (Brante & Strømsø, 2017) is an important part of MD selection and reading (e.g., Britt et al., 2013). Sourcing (Wineburg,

1991) is a form of strategic reading behavior deemed as a crucial for MD selection, integration and comprehension (Cho, Afflerbach & Han, 2018). Accomplished readers evaluate source information in conjunction with documents' content. They perceive documents as social artifacts (Britt et al., 2013), and as such parts of human social discourse. Sourcing strategies are an important foundation for approaching reading material critically and with vigilance.

The change in reading requirements are reflected in steering documents both nationally and internationally. The Organization for Economic Cooperation and Developments (OECD) definition of reading literacy is set forth as:

Reading literacy is understanding, using, reflecting on and engaging with written texts, in order to achieve one's goals, develop one's knowledge and potential, and participate in society

(OECD, PISA for Development Brief 8, 2016, para.1).

This definition puts the reader at the center of the reading activity, describing reading as an active process instrumental for reaching important goals.

Developing mature, responsible and active readers, is an important task for educators. In accordance with the OECD, national curriculums describe critical reading and source evaluation as parts of developing literacy. However, there can be differences across nations in how these competencies are presented. Brante and Stang Lund (2017) found that literacy skills were somewhat differently described in the national steering documents of Norway and Sweden. For example, in the Norwegian curriculum LK06, (The Norwegian Directorate for Education and Training, 2006), literacy regarding document skills and competencies are described holistically. This entails descriptions of what a full set of skills in critical reading and source evaluation means. Based on LK06, teachers will have to evaluate to what degree students have reached this ideal set of goals. In Swedish curriculums, on the other hand, multiple document reading competencies are specified in accordance with different levels of the grading system (Swedish National Agency for Education, 2015). The Norwegian Directorate for Education and Training are over the next two years implementing a new national curriculum. In the part that describes overarching aims, themes and skills relevant to all disciplines and all grade levels, critical thinking and source evaluation are described as major targets. For example, students should know how to critically evaluate different sources

of knowledge. They are also to think critically about the origins of sources and how knowledge is constructed.

Critical reading and source evaluation skills are sophisticated competencies. Indeed, empirical evidence repeatedly demonstrates that paying attention to sources is not a skill that can be taken for granted in students. In 2012, Walraven, Brand-Gruwel and Boshuizen conducted a classroom study based on the observation that many students lack competencies in accessing useful documents on the internet, for the purpose of solving school tasks. Students also had problems in evaluating the trustworthiness and relevance of documents. As a result, student products were often the result of “cut and paste” strategies. Similarly, a study was conducted by Goldman, Braasch, Wiley, Graesser and Brodowinska (2012) with participants who were taking an introductory class in psychology. They found that the participants seldom attended to source information when evaluating documents, in terms of quality of knowledge, and trustworthiness. This is in line with Wineburg’s (1991) classic study, where he found that high school students mostly do not use source information when working with a set of documents. In other words, students of different ages, mostly do not attend to source information when working with multiple texts. *Sourcing* is a term first introduced by Wineburg (1991). It refers to strategically using source information in the meaning making process of reading. Sourcing means attending to, representing, evaluating and using source information (e.g. about the author, publication, date of publication etc.) in the meaning making process (Bråten, Stadtler, & Salmerón, 2017).

Even if students of various age groups, seldom spontaneously engage in sourcing, the possibility of creating a reading environment that teaches the use of sourcing strategies seems likely. For example, Nokes, Dole and Hacker (2007) did an intervention study with senior high school students. The results showed that reading multiple documents in history while simultaneously receiving instructions in MD strategies, increased the use of strategies and improved learning of historical content. Braasch, Bråten, Strømsø, Anmarkrud and Ferguson, (2013) showed how use of sourcing strategies differed between control and intervention group after a 60 minutes intervention. There is also empirical evidence of how a computer based tutorial practice environment can improve MD strategic reading, such as sourcing (Britt & Aglinskis, 2002). For a review of intervention studies about sourcing, see Brante and Strømsø (2017).

Learning more about textual, format and individual, factors that influence MD reading behavior, with the focus on sourcing strategies, is the aim of this dissertation.

## 2 Multiple Document Reading

### 2.1 Reading Strategies

Understanding how different techniques and procedures can help readers in actively memorizing and learning new material, has been a focus of pedagogical psychology since the 1970s (Afflerbach, Pearson, & Paris, 2008). Instead of viewing learners as passive receivers of skills, the implication is that learners are capable of processing and structuring information in a deliberate and active manner. Research within the domain of strategic learning has revolved around how incoming information is processed and structured (Weinstein & Mayer, 1986).

What is a strategy, and what are the characteristics of strategic learners? The term *strategies* has been defined in different ways, depending on theoretical traditions and disciplinary domains (Anmarkrud, 2009). The focus on *reading* strategies has been a central part of reading research since the 1970s Michael Pressley has been an active contributor in developing the concept of reading strategies since the 1980s. He defines reading strategies as:

composed of cognitive operations over and above the processes that are natural consequences of carrying out the task, ranging from one such operation to a sequence of interdependent operations. Strategies achieve cognitive purposes (e.g. comprehending, memorizing) and are potentially conscious and controllable activities (Pressley & Hilden, 2006, pp. 512).

Cho, Afflerbach, & Han (2018) make a distinction between strategic cognitive operations and processes. Sometimes processes are neither interconnected nor planned. Strategies, on the other hand, are the deliberate application of processes. This distinction seems congruent with Pressley's definition. Pressley's definition points out that strategic reading can range from involving one simple cognitive operation to a sequence of interdependent operations. It is not altogether clear what Pressley means by *interdependent* operations. It is however reasonable to suggest that Pressley's definition encompasses the numerous strategies described in the existing literature (Anmarkrud, 2009). The distinction between cognitive, deliberate operations and natural consequences of carrying out tasks may not always be easily defined. Nor is it always easy to draw the line between a strategy and a skill. Afflerbach, Pearson, and Paris (2008) offers that strategies are skills under conscious control, akin to two sides of the same coin. Furthermore, when a strategy develops into something more automatic and effortless it might be better categorized as just a skill (Afflerbach et al., 2008).

Reading online, to research a topic, often involves accessing more than one document. The introduction of internet reading and its increasing prevalence throughout society, has compelled researchers to look at strategic reading with multiple documents (e.g., Afflerbach & Cho, 2009; Cho, et al., 2018). Based on earlier theorists like van Dijk and Kintsch (1983) and Britt, Goldman and Rouet (2013), Cho, Afflerbach and Chan (2018) offers a definition of multiple document reading as: *...the act of constructing meaning through accessing, comprehending, and using texts* (pp.133). Multiple Document (MD) reading implies intertextuality. This means that the set of documents that are accessed in a MD reading situation, will inform the interpretation of one another in a reciprocal manner. A set of documents, about the same topic, can be more or less congruent. Sometimes MDs have discrepancies or conflicts in textual content. While strategies for single text reading are important for multiple document reading and understanding, more often than not, they are not sufficient for reading a set of documents. MD strategic reading involves, cross-textual linking (Cho, et al., 2018), and sourcing (Wineburg 1991) is an important strategy for cross textual linking (e.g., Britt et al., 2013; Perfetti, Rouet, & Britt, 1999).

## **2. 2 Sourcing**

In the existing literature, there is some variability in how the term source is used (Braasch, Bråten, & McCrudden, 2018). In a broader sense it can mean all types of information resources like books, articles, television documentaries, to name a few. In a more restricted sense it can mean metadata information about a body of information. This information can be origin, including information about author, publication venue, date of publication and so on (Bråten et al., 2017). Source information can also refer to purpose of author or publication venue, including level of benevolence. The level of trustworthiness and expertise are also relevant characteristics of source information (Britt, et al., 2013). Metadata potentially inform readers in contextualizing bodies of information, which may guide them in their reading. One potential challenge for readers is that the source information for online reading documents may not be available.

In Wineburg's seminal work (1991) he identifies three learning strategies. One is *corroboration* which involves comparing a set of documents and evaluating them in a reciprocal manner. He names a strategy called *contextualization* which means evaluating and understanding documents in the context of the time they were produced, and the place of their origin. He also introduces the concept of *sourcing*. Wineburg compared expert historians with high-school students, when interpreting a set of historical documents. An important difference

between the experts and the younger students, was the degree to which they used comprehension strategies. With regards to sourcing, the experts initiated the process of interpreting the historical documents by paying attention to source information, whereas the high-school students mostly overlooked source information. The differences found between the scholars and the younger students seem to indicate that sourcing strategies, is mostly limited to expert readers. That less experienced readers often overlook source information in a multiple document reading situation, is demonstrated in research (e.g., Bråten, Strømsø, & Andreassen, 2016; Goldman, Braasch, Wiley, Graesser, & Brodowinska 2012; Walraven et al, 2012;).

After Wineburg introduced the term sourcing, it has been widely used in the literature concerning multiple documents reading processes, strategic multiple documents reading and multiple documents reading comprehension. Sourcing is a compounded construct that encompasses numerous strategies. It means attending to, representing, evaluating and using source information (e.g. about the author, publication, date of publication etc.) in the meaning making process (Bråten et al., 2017). It means evaluating this information on several dimensions including quality, authenticity, relevance and reliability (Bråten, McCrudden, Stang Lund & Brante, 2018). There are several reasons why sourcing is crucial in a multiple document reading situation. Reading multiple documents focusing merely on content, disregarding source information (“who says what”) may create more confusion than clarity (Britt et al., 2013; Bråten & Braasch, 2017; Rouet 2006;). Documents that appear to readers as dealing with the same topic, may actually present diverse information. Sometimes readers find discrepancies in documents’ content. Sourcing provides context which may be crucial for readers when interpreting the coherence of content (e.g., Braasch & Bråten, 2018; Statdler & Bromme, 2014). For instance, a lay-person who reads information that sun-bathing is beneficial to health, may experience a break in coherence, since they were warned against skin cancer in an appointment with the family doctor a few days ago. Learning that the positive information about sun tanning is written by a representative of a tanning salon franchise, affords context that may explain the opposing claims.

Use of sourcing strategies may improve reading outcome. A number of correlational studies have shown that the extent to which students consider source features, may predict learning and comprehension (e.g., Anmarkrud, Bråten, & Strømsø, 2014; Strømsø, Bråten, & Britt, 2010). Source intervention studies have shown positive outcomes for readers on different dimensions. For instance, in a study by Braasch and colleagues (2013) students that received



sourcing instructions, demonstrated a better use of difficult concepts after the intervention. In addition, they were also better at making use of source information when evaluating documents, compared to students in the control group. In the same vein, a classroom study (Nokes et al., 2007), demonstrate how history teaching, involving multiple document reading strategies, such as sourcing, improves not only development of strategic reading, but increases the learning of historical content. In sum, use of sourcing strategies play an important role in MD reading and comprehension.

To investigate strategic use of sources in MD reading, it is useful to understand more about what comprises sourcing behavior. Sourcing is a compounded concept. Based on an extensive number of studies Afflerbach, Cho and Han offers a taxonomy of multiple documents reading strategies (2018). *Sourcing* is one of the categories, listed under the heading *Critical analytical processing*. Sourcing strategies are described as:

Recognizing and attending to the explicit markers of source reliability and trustworthiness: Author credentials (e.g., the degree of author expertise indicated by areas of work, professions, affiliation, positions) and source features (e.g., when, where, how, and by whom a source was created, used and promoted). Comparing the analysis of author identification and source information done for different information sources to make accurate prediction of the reliability of a particular source.

(Cho, Afflerbach, & Han, 2018, pp. 137-138).

In the taxonomy, descriptions of sourcing strategies involve an extensive set of strategic sourcing behaviors. Sourcing strategies as listed in the taxonomy by Cho and colleagues (2018), involve attending to source markers. The taxonomy also includes, in its description of sourcing, comparing different sources to make predictions about source reliability.

The direct access to an unlimited amount of information is, on the face of it, vastly beneficial for many people. It can be seen as a form of democratization. Paradoxically, these new advantages may represent disadvantages for a sizeable number of the reading population, if readers lack the necessary strategies to benefit from the abundance of information resources. MD reading requires more than the comprehension of one text and its content (Cho et al., 2018). Without the necessary cognitive tools some readers may be left behind. Given the complexities of MD reading, there is a risk of developing societies with an unprecedented gap between better and poorer learners.

### **2. 3 Documents Model**

There are several current conceptualizations of reading literacy (Stang Lund, Bråten, Brante, & Strømsø, 2017). Relevant to this dissertation is the groundbreaking Documents Model (DM) (Britt et al., 2013; Rouet, 2006;). The DM is an extension of Kintsch's (1998) Construction Integration (CI) model, which refers to single text processing and comprehension. The CI is a model of cycles in text comprehension. According to Kintsch texts have to be processed segment by segment, and integrated with the part of the text previously read, currently held in working memory. The CI is a two-layered model of comprehension. The text-base consists of elements derived from the text, without adding anything that is not specified in the text itself. This representation is described as an impoverished and, in part, incoherent network (Kintsch, 1998). To make the structure coherent, the reader must establish nodes, and links between nodes, from their own prior knowledge or experience. Various sources of knowledge from the reader's experience must, be used to complete the interpretation of the text, including knowledge of the specific communicative situation. Readers attain a situation model, representing text comprehension, when text-base is integrated with relevant aspects of prior knowledge.

In 1999, Britt, Perfetti, Sandak, & Rouet, proposed the Documents Model (DM) framework representing readers' cognitive processing, and construction of understanding, when reading multiple documents. The DM is an extension of Kintsch's CI model, which applies to single text reading. The DM is a two-layered model, consisting of an inter-text model and an integrated mental model, which is sometimes referred to as a situation model. The inter-text-model is a structural cognitive mapping of relations between of documents. Sources that are connected to documents' content, are described as nodes. They are described as points in an inter-text network, intersecting and branching towards other document nodes (Britt, et al., 2013; Perfetti, Rouet, & Britt, 1999). Nodes create source to source links, as well as links between various documents' content. Linking documents may result in readers representing conceptual content relations, for example whether or not information is corroborated or refuted across documents. The cognitive representation of a topic or issue described across a set of documents, is referred to as the integrated mental model. Eventually a connection between the integrated mental model and the inter-text model can result in a full Documents Model (Britt et al., 1999). A full documents model is, within the terminology of the DM framework, optimal MD reading comprehension. Britt and colleagues (1999) presented four possible models of how readers might represent information learned from two or more related

texts. The four models vary along a dimension of integration, as well as in the degree of source tagging. The first possible model is the *separate representation* model, which assumes that readers form a unique representation of each text without connections among them. The second model proposed is the *mush model*, which is described as the opposite of the separate representation model. This model describes readers making information integration from all relevant texts, without tagging where any of the information came from. With the *tag all* model each and every event is tagged for its source. There are also links between document's nodes, meaning readers representing what sources support each other, what sources agree or disagree, and what sources give evidence for or against claims. The final model described, is most typical of a good reader's representation of a set of documents. The final model combines a situation model and an inter-text model, resulting in a *full documents model*. The full documents model is described as a highly integrated situation model of events learned, with only the most important events tagged for their sources. The document nodes in the fully elaborated model, will represent a lesser or greater amount of source information, depending on the quality of the source, in terms of for example, usefulness or trustworthiness, and also the reader's task (Britt et al., 1999).

Documents vary in the distinctiveness of how readers perceive their boundaries between them. According to the documents as entities assumption the extent to which readers perceive documents as separate entities, affects readers' ability to be aware of source information, (Britt & Rouet, 2011; Britt et al., 2013). Britt and colleagues (2013) consider three general factors that affect the likelihood of readers representing documents' sources as part of their integrated model of a situation. Firstly, readers are more likely to experience documents as entities when there are distinct boundaries between them. Boundaries between documents can sometimes be perceived as blurred when there are embedded references in a text. However, an author may provide textual cues signaling that they are referring to another document, thereby making boundaries between the author's document and the embedded reference more salient to readers. With MDs boundaries may be perceived as more salient when documents are distributed separately instead of being on a single paper. It can also be assumed that readers are more likely to experience documents as entities when source information is saliently presented, for instance at a top of a document. A book jacket with information and pictures of the author may draw readers' attention to the source of the book. Conversely, textual factors, like using passive voice, may draw less attention to the author. Sometimes discrepancies within a document or across documents, shows conflicting perspectives between sources. In

cases of discrepancies readers sometimes elaborate on the relationship between author and content (Braasch et al., 2012). When experiencing documents as entities, good readers will perceive documents as social artifacts, written at a certain time for a certain audience, by one or more authors (Britt et al., 2013, Britt & Rouet, 2011).

## **2. 4 Discrepancies Across Documents and The Discrepancy-Induced Source Comprehension Model**

MDs representing the same topic or issue, may in some cases present discrepant, and even conflicting views. Single texts may also have discrepancies within their textual content. In both cases readers may experience a break in coherence and may try to reconcile discrepant or conflicting claims. Sometimes conflicts in textual content exists because someone is trying to persuade readers towards their different positions (Petty & Brinol, 2012). Other times authors intentionally spread disinformation (Lewandowsky & Oberauer, 2016). Sometimes controversies in a set of documents exist because the nature of the topic or issue is intrinsically unresolved (Braasch & Bråten, 2018). Dealing with conflicts in MDs is a challenge for both inexperienced as well as more seasoned readers (Braasch & Bråten, 2018). However, in accordance with the documents as entities assumption (Britt, & Rouet, 2011; Britt et al., 2013), discrepancies may increase attention given to sources. Increased attention to sources may help readers reconciling discrepancies (e.g. Braasch et al., 2012). For example, assessing source information like authors relative expertise, trustworthiness or whether they have an agenda, may help readers in understanding why a particular author may hold one opinion, whereas another author claims the opposite. Take for example, information about sun and health issues. The issue of sun and health may look very different from the perspective of a cancer doctor concerned about D-vitamin levels in a northern population, compared to a beautician working with aging of the skin. When Braasch and colleagues (2012) introduced the Discrepancy-Induced Source Comprehension assumption (D-ISC), it was based on the assumption that text discrepancies can benefit readers in two ways. One, reading discrepant documents may promote deeper processing, and two, reading documents with discrepant textual content can promote better memory for sources. In two experiments participants read two brief news reports that were attributed to different sources. Results confirmed that readers mentioned more sources in summaries of discrepant stories, recalled more sources from discrepant stories, and displayed longer gaze times in areas of the documents with source information, compared to when reading stories with consistent textual content. The D-ISC assumption is by Braasch and Bråten (2018) described as a micro model stemming from the

DM. The D-ISC model has generated research with different types of texts, and in different reading contexts. For example, Kammerer, Kalbfell, and Gjerets (2016) let participants read two web pages before they wrote a recommendation based on the information from the two web pages. The texts participants read had either consistent or inconsistent textual content. Results from think aloud data, showed that readers made more evaluative comments about the “about us” page when reading inconsistent information. In other words, they paid increased attention to source information after reading inconsistent information. In their eye-tracking study Rouet, Le Bigot, de Pereyra and Britt (2016) found differences in readers’ processing as well as reading outcome, depending on whether participants read discrepant or coherent versions of short single texts. Results showed that readers fixated more often and gazed longer at source segments when reading discrepant relative to consistent news stories. In addition, readers cited more sources in summaries and recalled sources more often, after reading discrepant versions of the news stories, as compared to consistent versions (Rouet et al., 2016).

Contradictory to what happens when readers reconcile conflicting content, MDs with a high degree of semantic overlap, diminishes source recognition. Braasch, McCabe, & Daniel (2016) conducted a study where they compared reading of semantically congruent texts with reading semantically distinct texts. With semantically congruent texts source recognition was significantly poorer, relative to semantically distinct texts. Evidence also showed that participants had better recall memory for claims and evidence statements from semantically congruent texts, relative to texts that were semantically distinct. Guided by the Documents Model Framework (e.g., Britt & Rouet, 2012; Perfetti et al., 1999) Braasch and colleagues (2016) assume that congruent assertions or arguments, direct processing efforts towards creating an integrated mental model at the expense of encoding and remembering source characteristics. In the same vein, Maier and Richter (2013) found in their study differences in text processing, dependent on whether the texts were consistent or inconsistent with readers’ previously held beliefs. They found an advantage for belief inconsistent texts on the level of text-base. In other words, when reading presented content that was discrepant from participants’ beliefs, participants paid more attention to sources. Attention to sources is a prerequisite to constructing an inter-text model as described within the DM framework (Britt et al., 2013; Perfetti et al., 1999). In the study by Maier and Richter (2013) belief consistent texts benefited the construction of the integrated mental model. The differences in how readers distribute their strategic resources seem to be affected by the degree to which readers

experience conflicts or discrepancies in the reading process. Conflicts can be experienced as being within documents, across documents, or between documents and beliefs residing in the individual reader.

In 2014 Stadtler and Bromme proposed a theoretical process model. The Content-Source Integration Model (C-SIM) (Stadtler & Bromme, 2014) is similar to the D-ISC model in that it describes reading processes regarding conflict detection and reconciliation between conflicts. The model describes three stages of conflict detection, conflict regulation and conflict resolution. Stadler and Bromme (2014) present it as a taxonomic description of how readers comprehend conflicting scientific information. Readers may attend to conflicts in different ways. First readers set a standard of coherence that refers to the level of comprehension they seek to attain. A standard of coherence will be related to the task at hand. A question is how readers can accomplish coherence when textual content is inconsistent. In accordance with the C-SIM model there are three different prototypical ways of restoring coherence. Readers may a) ignore a conflict, b) reconcile a conflict, and c) accept a conflict as being caused by two or more opposing a sources. If readers find that the two first stages are impossible, in that ignoring or reconciling conflicts is futile, they may connect the conflicting propositions with their sources. Momentary break in coherence may then be interpreted as due to different sources having different perspectives, this position may help in restoring coherence in the reading situation. The C-SIM model is congruent with the DM framework and the D-ISC model, in recognizing that source to content integration plays a role in attaining coherence, in a reading situation with conflicting information within or across documents.

When Braasch and colleagues introduced the D-ISC model (2012) one of the assumptions was that conflicts or discrepancies in texts may promote readers' deeper processing skills. Along the same vein other scholars have discussed the benefits of learning in less structured environments. Spiro (1988) discusses how certain topics may be intrinsically ambiguous. His description of what it is like to learn in ill structured domains is in many ways analogous to reading situations with contradictory multiple document reading material. His Cognitive Flexibility Theory (Spiro, 1988) describes how readers learning in an ill structured environment can build incremental understanding of relationships between concepts. Learning in an ill structured environment demands more activity and effort on part of the reader. However, extra effort on part of the reader may lead to a deeper level of understanding (McNamara, Kintsch, Songer, & Kintsch, 1996). According to McNamara and colleagues

(1996) maximum coherence in texts improve surface based, superficial learning. Less coherent text material can lead to more active inference during reading, in that readers construct more links between incoming information and their personal-knowledge base. Cognitive representations that are at a level of understanding beyond text-base, make up what is known as a situational understanding of text, in Kintsch's terminology (1998). A situational understanding of text affects reading outcomes, such as being able to answer inference questions and problem solving questions. However, not all readers benefit from lack of coherence. Readers with low prior domain knowledge benefit from increased levels of coherence in reading material (McNamara et al., 1996). A preliminary conclusion may suggest that reading in a MD reading society may involve reading material that is incoherent, discrepant or presenting conflicts within domains. Learning in ill structured environments puts a toll on readers, but can lead to a deeper level of understanding. However, there is a dilemma, putting an extra toll on readers seems to mostly benefit more experienced readers, with high levels of domain knowledge within various fields. If MD reading, in many cases means learning in less coherent environments, as compared to reading coherent single texts, MD reading may mostly benefit readers that are experienced. If groups of readers are left behind, a question of whether such readers can be helped by reading instructions is of pedagogical interest.

It is difficult to state how cognitive processes underlying the D-ISC or the C-SIM model, can be explained. It may be that text propositions residing in working memory, act as retrieval cues for related concepts that become passively activated from long-term memory (Kendeou & O'Brien, 2014; Kintsch, 1998). The co-activation of cues in working and long-term memory may lead to a break in coherence in cases where cues are inconsistent (Kendeou & O'Brien, 2014). To reduce cognitive inconsistencies, readers may turn to source information to organize and interpret what they read (Braasch & Bråten, 2017). The C-SIM model is based on the premise that co-activation of conflicting propositions in working memory, conceptually related to information in long term memory, is triggered through a passive resonance process. These memory processes may result in readers noticing a break in coherence. With the C-SIM model, Stadtler and Bromme (2014) propose a three step model explaining readers' behavior when textual content offers conflicting perspectives. Readers might either fail to detect a conflict, or try to reconcile between conflicts. The third stage in the taxonomy is when readers take into account that different agents can hold different perspectives. Readers who attribute

conflicting claims to differences in positions between sources, may restore coherence by tagging documents for their sources.

In sum, different scholars have discussed how conflicting textual information may play a role in influencing trajectories of reading processes. Conflicts within or across documents can help readers attain a broader and deeper understanding of issues. Empirical evidence supports the idea that textual discrepancies may also promote sourcing. However, what constitutes the underlying cognitive processes of readers noticing conflicts and restoring coherence is difficult to say. It is, however reasonable to assume that conflicting texts may benefit some readers more than others. This is because restoring coherence when dealing with textual discrepancies constitutes complex problem solving, as compared to when reading coherent texts.



### **3. Individual Differences and Sourcing**

Multiple document comprehension is affected by external resources, such as the documents themselves, as well as by properties of the individual reader (Rouet & Britt, 2011). Readers bring to the table varying degrees of resources and preconceptions. Wineburg's study (1991) demonstrated that differences in prior domain knowledge and strategy knowledge shaped the expert readers processing of MD in a way that was unattainable for the younger students. Prior domain knowledge, strategy knowledge, reading skills and self-regulation skills vary among readers (Rouet & Britt, 2011; Rouet et al., 2017). These factors benefit and limit readers in varying degrees and will influence reading processes as well as reading outcome. In this section I will present the individual differences related to what we measured as co-variates.

#### **3.1 Prior Topic Knowledge**

Prior topic knowledge is included in all contemporary models of text comprehension. It is a critical factor in readers' construction of meaning (McNamara & Magliano, 2009). Kinstch's (1998) Construction-Integration model of single text comprehension, for example, shows how deeper mental representations are constructed when readers integrate prior topic knowledge with content from a text. It has also been demonstrated in research how prior topic knowledge affects aspects of MD reading and understanding (Bråten et al., 2007). Whether prior knowledge is of particular importance in MD reading compared to the role it plays in single text, is less certain (Barzilai & Strømsø, 2018). It is possible that the potential lack of coherence in MD reading demand more from readers in terms of prior knowledge, than single documents that are intentionally authored to be more coherent (Barzilai & Strømsø, 2018). When readers experience a break in coherence trying to integrate MDs, prior topic knowledge can help in evaluating the documents. Prior topic knowledge can also involve having knowledge about sources within certain domains. It may be assumed that having knowledge about different sources makes reconciling between them in terms of for instance, trustworthiness and expertise more easy to achieve. Readers' use of sourcing strategies may be influenced by their level of prior topic knowledge (McCrudden, Stenseth, Bråten, Strømsø, 2015). In a study by McCrudden and colleagues (2015), upper secondary students read documents about topics that were either familiar or less familiar to the participants. Results showed that when readers read documents with unfamiliar topics, they attended more to source information like source's expertise and trustworthiness. When students read documents with familiar topics they relied more on their own prior knowledge. The results of the study

seems to indicate that when readers perceive that their level of topic knowledge is high, source information may become less relevant to them. However, it is not feasible to generalize these findings to all groups of readers. As demonstrated in Wineburg's (1991) study, expert readers, with high levels of topic knowledge, actively use source information when they read. This was in contrast to the eight grade students who had limited knowledge about the domain.

### **3. 2 Prior Topic Beliefs and Attitudes**

Prior topic beliefs and attitudes influence acquisition of knowledge. It has been demonstrated how incorrect topic beliefs can hinder new learning (Kendeou & O'Brien, 2016). Prior topic beliefs and attitudes seem to affect MD reading as demonstrated by several studies.

Particularly this seems to be the case when reading conflicting information in a set of documents. In a study by van Strien, Kammerer, Brand Gruwel and Boshuizen, (2016), participants with strong prior beliefs and attitudes wrote essays that were more one-sided, after reading conflicting information on a web- site. Prior topic beliefs and attitudes may also affect memory for sources. In a study by Maier and Richter (2013) participants read a set of documents with discrepancies in textual content. Some of the documents' content were consistent with participant's beliefs and attitudes, some were inconsistent. Results revealed that participants had better memory for sources when reading textual content inconsistent with their prior beliefs, compared to when reading belief consistent texts. In the same vein, Pereya, Britt, Braasch, and Rouet (2014) proposed the Plausibility-Induced Source Focusing (P-ISF) assumption. The P-ISF model holds that when readers try to make sense of documents with textual content they deem as implausible, they may look to sources for more information. In sum, prior topic beliefs and attitudes may influence information acquisition, memory for text content and memory for sources, when reading MDs.

### **3. 4 Interest**

Several studies have documented that readers' interest affect MD comprehension (e.g., Bråten at al., 2014). Individual topic interest refers to readers' stable and sustained positive orientation towards a topic or domain (Schiefele, 2009). In 2017 List and Alexander presented the cognitive affective engagement model (CAEM) of multiple source use. The model is a way of unifying cognitive and behaviorally focused models, with research focusing on engagement and affective factors, such as interest. The model proposes that readers can be defined along two dimensions, regarding their level of affective engagement, and behavioral skills and habits. The model proposes that readers fall into different default stances, where

being high on affective engagement in combination with having high levels of evaluative reading skills and habits, is the profile most beneficial to MD reading, and comprehension. Individual differences in default stances, affect a number of text use behaviors, such as selection of texts and document evaluation. Readers' stances also determine performance outcome, including text recall and integration. The CAEM model describes how motivational, affective factors, such as interest, may impact MD reading processes, use of strategies and reading outcome.

### **3. 3 Critical Reading**

Readers differ in how they judge the plausibility of new information. Some readers try to single out the correct answer to a problem. Others view knowledge as more tentative and complex (Ferguson, Bråten, & Strømsø, 2012). The last group may be more likely to put in more effort when reading new information. Critical reading may involve paying attention to more view-points, and evaluating the quality of evidence that is presented. In a study by Bromme, Scharrer, Statdler, Homberg, & Torspecken (2014), they found that lay-people were able to take into consideration scientific discourse features, such as citations and method description, when reading about scientific controversial issues. The CAEM model (List & Alexander, 2017) identify a critical analytical approach as one out of four possible, readers' default stances. In terms of multiple source use, this stance involves habits that are critical and evaluative, as well as engagement on the part of the reader. Out of the four default stances, the critical analytical approach is seen as the most beneficial to MD reading. Critical reading may involve elaborative, and reflective processing. A critical reading approach may ultimately play a part in knowledge building (List & Alexander, 2017).

### **3. 5 Working Memory**

Individual differences in working memory (WM) influence readers' ability to integrate semantic content and making connections between information and prior knowledge (Barzilai & Strømsø, 2018). Braasch and colleagues (2014) found that upper-secondary students working memory capacity predicted intertextual comprehension. Only a few studies have found that working memory is related to MD reading (e.g. Banaz & Sanchez, 2012) However, it seems likely that the complexities and ambiguities, that sometimes comes with reading more than one document, puts an extra toll on WM (Barzilai & Strømsø, 2018). There is general agreement that the correlation between WM and text comprehension increases when readers are challenged with complex tasks such as reading ambiguous information (e.g., Just & Carpenter, 1992). MD reading involves representing similarities and discrepancies across

documents, as well as tagging documents for sources, which means simultaneously processing and storing diverse information.

### **3. 6 Gender**

Gender differences in reading abilities exist according to international assessments. Typically girls outperform boys (OECD, 2016). However, it is not clear that these findings translate to MD reading (Barzilai & Strømsø, 2018). MD reading skills may be affected by digital experience and competence. Women have been found to score lower than men on self-reported Internet skills which, in turn, predicts engagement in online activities (Hargittai & Hsieh, 2013). Also, girls have expressed less positive attitudes towards recreational digital reading, compared to boys (McKenna, Conradi, Lawrence, Jang, & Meyer, 2012). Whether these differences make girls and women less capable of strategic, critical MD reading, which includes sourcing, is not clear.

### **3. 7 Chapter Summary**

Reading in the 21st century often means reading MDs on digital platforms. Strategic reading of a set of documents can therefore be seen as a form of digital competency. Theoretical assumptions as well as empirical evidence, support that source to content integration is an important prerequisite for constructing an integrated situation, or mental model, when reading a set of documents. Strategic reading based on source information in the meaning making process, is in the existing literature often named as sourcing (Wineburg, 1991). In close collaboration with the research team, Critical Reading and Learning at the University of Oslo, I have investigated factors that influence source to content integration, as measured by memory for source to content links. The results of our investigations are three studies, which are the basis for this dissertation. In the following chapters I will discuss the studies. The discussions will encompass methodological and theoretical questions. I will bring into question limitations of the studies as well as suggestions for future research. Finally, I will discuss how the study results may suggest some practical and pedagogical implications. The three separate research questions are in part overlapping, and in part different from each other. All three studies have in common the investigation of the relationship between memory for conflicts across texts and memory for source to content links.

## **4 Methodological Considerations**

This thesis is based on three empirical studies based on three distinct sets of data. All three papers employ quantitative analysis. The first paper is a correlational study, the second and third study are experimental studies.

### **4. 1 Participants**

Participants in study I and II were adolescents in upper secondary schools. In the third study participants were undergraduates. Adolescents and young adults, that undergo education, deal extensively with varying information resources. In upper secondary schools and at universities every student in Norway has access to personal computers. This means that tasks that include MD reading are relevant to them, as well as something they are used to. We adjusted the reading material in terms of readability to match the two different age groups. This will be further described under the section 4. 4. 2. In addition, we had some reason to believe that the topic of sun and health had relevance to participants in these age groups, this will be discussed further under the section 4. 9. It is reasonable to assume that studying conflicting cognitive representations across texts is not feasible with participants unless they have reached a certain stage of cognitive development. Adolescence is a time when cognitive skills development move beyond the concrete forms of knowledge associated with childhood, towards more abstract representations of multidimensional issues (Keating, 1990).

### **4. 2 Study I**

To get access to the participants we contacted the principal in an upper-secondary school in the south-east region of Norway. She arranged for teachers to clear the schedules of two classes for us to collect the data. Participants were 86 students from two classes at an upper secondary school. Mean age was 16.74 years. Students were all taking college preparatory classes. Most of the participants were native-born Norwegians. The sample was relatively homogenous (i. e. middle class) with respect to socioeconomic status.

#### **4. 2. 1 Reading Material**

Participants read four printed expository texts about a scientific controversial topic, sun and health. On the one hand, being in the sun without protection, may lead to skin cancer. On the other hand, sunlight increases vitamin D production. Exposure to sun has also been connected to psychological health. The texts discussed whether long winters may increase the prevalence of depression particularly in the northern populations. The four texts were divided into opposing pairs, with one pair focusing on physical health, and the other pair focusing on psychological health. Each document within each pair, presented two claims with directly

opposing viewpoints being given in the opposing document. Making a total of four conflicts, or discrepancies, across all four texts. The four texts ranged in length from 210 to 240 words. We used Björnsson's (1968) formula to assess readability scores, which is based on text length, sentence length and word length. Readability scores were at a level comparable to the difficulty level of textbooks used in Norwegian upper secondary school. There were three main reasons for choice of topic. Firstly, the topic represents a scientific issue with authentic controversies. Secondly, based on the curriculum of Norwegian upper secondary school, students were expected to have some degree of prior knowledge about the issue of sun and health. Thirdly, in terms of topic relevance sun and health may be of particular interest for adolescents and young adults in northern regions. Long winters means that lack of sun exposure may lead to vitamin D deficiency. Paradoxically, even if winters are long, Norway has a high prevalence of skin cancer. One reason for this is that many people cease the opportunity to be in the sun when they have the possibility. In addition, according to the Norwegian Cancer Association (2009), approximately 50% of young people reported using a sunbed during the last year, indicating that sun exposure is considered as part of a beauty and well-being regime for many young people. The texts were based on authentic material, only slightly modified in terminology and syntax to fit the adolescent reader. Also the texts were uniform in length and readability to make them applicable for a research setting. Source information was saliently presented at the beginning of each text.

#### **4. 2. 2 Prior Knowledge Measure**

We distributed a folder to each participant with reading material and pre- and post-measurements. First participants were measured on their prior topic knowledge. Participants' prior knowledge about the topic presented in the four expository texts, was assessed by means of a 20-item multiple choice measure. The 20 items covered both physical and mental health issues in relation to sun and health. A previous version of this measure had been used and validated in prior research (e. g. Ferguson & Bråten, 2013; Bråten et al., 2014). This version had also been reviewed by a professor of biochemistry at the University of Oslo. Participants' scores were based on the number of correct responses out of the 20 items. The reliability (Kuder-Richardson 20) for scores on the measure was 0.68. The prior topic knowledge measuring items were relatively diverse. Some items were questions about health issues related to sun, and other items were related to health issues in general.

#### **4. 2. 3 Interest Measure**

We assessed participants' interest and engagement in health issues with an 8-item measure, in which participants indicated their level of interest and engagement by rating each item on a 10-point Likert-type scale ranging from 1 (not at all true of me) to 10 (very true of me). Half of the items assessed interest in health issues without reporting any active engagement or involvement (sample item: I am interested in conditions that affect our health). The other half of the items focused more on participants' active involvement and engagement in health issues, reflecting their intentions to lead healthy lives (sample item: I am concerned about how I can take care of my own health). Participants' scores on this measure had an internal consistency reliability (Cronbach's  $\alpha$ ) of 0.91.

#### **4. 2. 4 Inventory of Critical Reading Strategies**

We distributed an inventory of critical reading strategies which is an assessment of participants' likelihood of critically evaluating science related information they may encounter in diverse media. The Critical Reading of Media Reports of Science Scale (CROMROSS), was recently used and validated by Strømsø, Bråten and Stenseth (2017). We measured critical reading strategies on a 6-item, 5-point Likert-type scale. On the CROMROSS participants were asked to rate their agreement with statements concerning how they deal with information about scientific issues presented in popular media, with all six items, included in the scale, addressing to what extent readers judge the plausibility of claims through critical thinking (sample item: When I see claims about new knowledge and new discoveries in the media, I consider how well justified these claims are). All six items were rated on a 5-point scale (1 = very seldom, 5 = very often). The internal consistency reliability (Cronbach's  $\alpha$ ) for participants' scores on this measure was 0.88.

#### **4. 2. 5 Conflict Verification Task**

We measured conflict recognition by administering a Conflict Verification Task (CVT). This measure has been used in earlier studies (Stadtler, Scharrer, Brummenrich, & Bromme, 2013; Stadtler, Scharrer, Skodzik, & Bromme, 2014). Participants are presented with 20 statements followed by two questions each. The first question was "Is this claim consistent with what you read in one of the texts?", and the second question was "Did you read anything in one of the other texts that is in conflict with this claim?" Both questions were to be answered with "yes" or "no". Eight of the twenty statements on the CVT were paraphrases of textual claims

that conflicted with a claim presented in another text (“attractor items”), eight were paraphrases of textual claims that did not conflict with a claim presented in another text (“uncritical items”), and four were claims about health issues that were neither presented in any of the texts nor were in conflict with any claim presented therein (“distractor claims”). In accordance with Stadtler and colleagues (2013; 2014) we corrected for a tendency to answer in the positive when computing participants’ scores on the CVT. Thus, each participant received a CVT score based on the difference between the proportion of the attractor items for which both questions were answered in the affirmative and the proportion of the uncritical items for which both questions were answered in the affirmative (i.e., false positives). This resulted in CVT scores that theoretically ranged from -1 (when none of the attractor items were identified as conflicting claims and all of the uncritical items were identified as conflicting claims) to 1 (when all of the attractor items were identified as conflicting claims and none of the uncritical items were identified as uncritical claims). The internal consistency reliability (Cronbach’s  $\alpha$ ) for participants’ scores on the CVT was 0.76.

#### **4. 2. 6 Sourcing Performance Task**

To measure memory for source to content link we used a sourcing performance task, used and validated by Strømsø, Bråten, & Britt (2010). With this task, participants are presented with four text sentences, one from each text, and four distractors. The four distractors were connected to the topic of sun and health but the sentence’s content were not covered in any of the four texts. Each of the eight sentences were followed by five letters (A-E). The first four letters (A-D) representing one of the sources and the last letter E representing the distractor sentence. Participants were instructed to mark a letter (A-D) for each sentence indicating the source of this information, alternatively, they were asked to mark a sentence (E) if the information did not come from any of the sources. Participants received one point for each of the eight items they marked correctly. Internal consistency reliability (Cronbach’s  $\alpha$ ) for participants’ scores on this measure was 0.66.

#### **4. 2. 7 Statistical Model of Analysis in Study I**

Multiple regression analysis was used in the first study. This is a linear model where more than one predictor variable is used to predict the value of an outcome variable (Field, 2013). Deviation from a normal probability distribution is quantified by the level of skewness (Field, 2013). None of the score distributions were substantially skewed, skewness ranged from 0.95 to 0.07. Hence, our data were considered suitable for use in a parametric statistical analysis. To address our specific research question, a forced-order hierarchical two-step multiple



regression analysis was used. In step 2 only memory for conflicting information was a statistically significant predictor of sourcing.

## **4. 3 Study II**

### **4. 3. 1 Participants**

In study II participants were 140 students from six classes at an upper secondary school. Mean age was 16.21 years. Students were all taking college preparatory classes. The sample was relatively homogenous (i. e. middle class) with respect to socioeconomic status.

### **4. 3. 2 Reading Material**

Like in study I, in study II we distributed a folder with printed reading material and measuring instruments. The four documents were the same as the four documents distributed in study I, with regards to sources, textual content and readability. The distribution of documents in study II however, were presented in two different formats. In one presentation format, participants read about the issue of sun and health in four separate documents. In another presentation format, participants read the same documents as a 969-word single text. We estimated readability of the single text using Björnsson's (1968) formula (readability =41).

### **4. 3. 3 Measuring Instruments**

Except for the exclusion of Inventory for Critical Reading Strategies, Pre- and post- test measuring instruments were identical to those we administered in study I. The internal consistency reliability for all measures, gave the following values: Prior Topic knowledge measure: (Kuder Richardson 20) .66., interest measure: (Cronbach's  $\alpha$ ) of .92., Conflict Verification Task: (Cronbach's  $\alpha$ ) of .73. and Source to Content Integration Task .65.

### **4. 3. 4 Statistical Model of Analysis in Study II**

In study II we used path analysis, which is an extension of the regression model. Goodness of fit statistics is calculated to assess the fitting of the model to the data set. The data set is expressed in an empirical covariance matrix, and the model produces an estimated population covariance matrix. (Tabachnick & Fidell, 2014). In study two we hypothesized that memory for conflict would directly affect memory for source to content links. We also hypothesized that text format, as well as individual differences variables, would have direct as well as indirect effects on student performance. The fit of the hypothesized model was tested by means of the Mplus 7.11 software, using maximum likelihood path analysis. The fit indices did not indicate that the hypothesized model fit the data well. Therefore, we specified and reevaluated the model by deleting two statistically non-significant paths and one non-

significant correlation. Additional adjustments of the model are described in article II (pp. 17-18). Fit indices indicated that the reevaluated model fit the data well.

#### **4. 4. Study III**

##### **4. 4. 1 Participants**

Participants were 85 students at a University in Norway, who were enrolled in bachelor (n = 77) and master (n = 8) level programs in education, humanities and social sciences. None of the study programs included any subject related to the topic of sun and health, discussed in the documents that were used in the present study. The sample included 64 females and 21 males who ranged in age from 19 to 47 years with an overall mean age of 24.07 years. Of all the participants 77.7% had Norwegian as their first language, and the rest were bilingual. The sample was relatively homogenous in terms of socio- economic standing.

##### **4. 4. 2 Reading Material**

Participants read four separate documents that were adapted versions of the documents previously used in study I and II. Documents were distributed on a mock-up scientific website designed by the researchers. Half of the paragraphs were hyperlinked, the other half without links. With this Randomized Control Trial (RCT) experimental, within-participants design, we were interested in measuring the effect of hyperlinks on conflict detection and sourcing. A within-participants design can help reduce the errors associated with individual differences. All participants were reading both claims that were linked and claims that were not linked. Which of the four claims that were linked to conflicting claims in another document and which were not, was counterbalanced across participants. When clicking on a link, the conflicting claim in another document “popped up”. The “pop up balloon” covered the text first text so that participants had to close the balloon to continue reading. The information in the balloons were opposing claims taken verbatim from another document, and included claims as well as elaborations of claims. Source information was also presented in the pop-up balloons.



Figur 1 Example of text with pop-up balloon

#### 4. 4. 3 Experimental Conditions

Task instructions were manipulated using a between-participants design. Half of the participants were given a “weak prompting condition” whereas the other half were given a “strong prompting condition”. Prompting conditions were randomly assigned. On the page containing the task instruction, all participants read the following statement:

You are now going to read four different expository texts about sun and health on a website. When you have read the texts, we will give you some questions to see what you have learned. Please notice the links within the texts. By clicking on these links you will get more information.

For participants randomly assigned to the strong prompting condition, the instruction continued as:

To get a more complete understanding of the discussion surrounding sunlight and health, it is necessary that you click on the links.

We hypothesized that the strong prompting condition would increase the perceived utility value of clicking on links (Wigfield & Eccles, 2000). Thereby motivating participants to access and assess conflicting claims.

#### 4. 4. 4 Working Memory Measure

Working memory capacity was measured with a Norwegian adaption of Swanson and Trahan’s (1992) Working Memory Span Task previously used and validated in prior Norwegian samples (e.g., Braasch et al., 2014). Twelve sets of unrelated sentences were read aloud with a 2-second interval between each sentence. The sets of texts gradually increased

from two to five sentences. Participants did two tasks simultaneously a) After hearing a number of sentences read out loud, they answered a comprehension question referring to one of the sentences b) then the participants had to remember the final word of each of the sentences they heard. For each of the 12 trials, participants received 1 point if they correctly answered the comprehension question and one additional point for each of the final words they recalled. If participants did not answer the comprehension question correctly, they were not awarded any points for that particular set. The scoring system, ensured that participants not only treated the task as one of verbal memory only, by remembering the final word of each sentence being read. Answering the comprehension question, correctly or incorrectly, indicated whether the participants had processed the sentences being read. The reliability estimate (Cronbach's  $\alpha$ ) for participant's scores was .70.

#### **4. 4. 5 Conflict Verification Task and Source to Content Integration Task**

We adapted the Conflict Verification Task and Source to Content Integration task, used and validated in study I and II. Task were adapted to fit the adapted texts. In the new texts the number of conflicts were increased from a total of four conflicts to eight conflicts. The Conflict Verification Task was adapted to cover the increased number of conflicts in the new texts. Procedures of analysis of the conflict Verification Task were the same in study three as in study I and II, controlling for tendency to answer in the positive following Stadler and colleagues (2013, 2014). Reliability estimate (Cronbach's  $\alpha$ ) for participant's scores on the Conflict Verification Task was .66. The Source to Content Integration Task was adapted to the content in the texts used in study III. The reliability estimate (Cronbach's  $\alpha$ ) for participant's scores on the Source to Content Integration Task was .63.

#### **4. 4. 6 Statistical Model of Analysis in Study III**

For study III we used mediation which is a special case of path analysis (Jose, 2013). In mediation, the emphasis is on the mechanism that operates between the two predictors and the outcome. Jose (2013) relies on an article by Baron and Kenny (1986) when referring to a list of conditions to test the mediation hypothesis. The independent variable must be significantly correlated with the mediating variable, the mediating variable is significantly correlated with the dependent variable, and when paths to and from the mediating variable are controlled for, the path between the independent variable and dependent variable is no longer significant. With mediation a concern may be that the independent variable and the mediating variable are too highly correlated, which is a case of multicollinearity (Jose, 2013). Like path analysis mediation is presumed to be a causal model. However, questions concerning causal direction

may arise (Jose, 2013). This will be further developed in chapter 6. In study III a parametric test of correlations (Pearson's  $r$ ) were used to assess the degree and strength of the relationship between the variables. The manipulated variable of prompting conditions did not produce the expected results. The prompting condition was not statistically significantly related to any of the measured variables. However, the number of times participants clicked on the linked claims was positively correlated with their scores on the CVT. This correlation was due to the CVT scores based on items referring to linked claims. CVT scores based on items referring to the linked claims, were statistically significantly correlated with scores on the Source to Content Integration task. The correlational pattern allowed for the testing of the hypothesis that conflict detection would mediate the effect of accessing conflicting claims by way of hyperlinks, on memory for source-content integration. Bootstrapped results showed positive statistically significant indirect effect of clicking on linked claims on source-content integration, via conflict detection. The direct effect of clicking on source-content integration was not significant in the mediation model.

#### **4. 5 Construct Validity**

Theoretical constructs are prevalent in educational research. This means that many of the variables measured cannot be directly observed. Construct validity involves making inferences from sampling of a study, to a higher order construct (Shadish, Cook, & Campbell, 2002). Construct validity refers to the degree of coherence between constructs as being theoretically defined, and the construct as operationalized and measured (Shadish et al., 2002). For example, the instrument we used to measure sourcing, measures memory for source to content links. A question is if we, by measuring levels of memory for source to content links, can make inferences about sourcing, which is a theoretical construct. When Wineburg (1991) introduced the term sourcing he described it as a discipline-based heuristic device that expert historians use in predicting, interpreting, and creating an integrated mental representation of a set of documents. Since then several scholars have described and defined sourcing strategies. The taxonomy presented by Cho and colleagues (2018) describes the strategy of sourcing in some detail. For example: "Recognizing and attending to the explicit markers of source reliability and trustworthiness" (Cho et al., 2018, pp.137). The DM framework (e.g., Britt et al., 1999) includes sourcing strategies as reading behavior fundamental in constructing the inter-text model. Measuring memory for source to content links, is relevant to theoretical conceptualizations of sourcing as it is described in for example, the DM framework. Representing source to content links are necessary to build an inter-text

model (e.g. Britt et al., 2013. Measuring source to content links is also relevant to the C-SIM model (Stadtler & Bromme, 2014), where representations of source to content links can work as a way for readers to restore coherence when reading incoherent content across documents. Measuring sourcing strategies is a question of construct validity and operationalization. Whether we have captured one or more elements of sourcing by our measurements is a relevant question. However, several models of MD reading describe constructing cognitive representations of source to content links, as part of readers' strategic use of source information.

Construct validity refers to the validity of the inferences that can be drawn from the measurement scores (Lund, 2002). For instance, in our studies we measured topic interest and propensity for reading critically, with self-report instruments. Self-report measures are sensitive to intentional or unintentional self-deception (Paul & Crost, 2004). Capturing the true values of these constructs may be influenced by the degree to which some participants shape their answers in a direction they think is favorable. In other words, students may have reacted to what they perceived as *experiment expectancies* (Shadish et al., 2002). However, Niessen, Meijer, & Tendeiro (2017) hold that self-presentation is less common in low-stake environments. Our research may have been perceived by students as taking place in low-stake environments. For example, students were not graded for any of their endeavor and we made it clear that their answers were anonymous. On the other hand, low stake anonymous situation may also mitigate students' efforts. To the extent that they did not put in their best work, we might not have captured the true value for example, of their prior-knowledge measurements. Prior-knowledge measurements were the most extensive and effort demanding test the students had to take. A threat to construct validity inferences based on particularities of the research situation is named by Shadish, Cook and Campbell (2002) as *reactivity to the experimental situation*.

#### **4. 6 Internal Validity**

We use the term internal validity to refer to inferences about whether observed covariation between A and B reflects a causal relationship from A to B in the form by which the variables were manipulated or measured.

(Shadish et al., 2002, pp. 53).

A premise for making causal inferences is that variable A precedes variable B in time. In the event of experimental research, the assumption is that causality flows from the event or

situation (Jose, 2013). However, causal order is a problem in non-experimental research or cross-sectional work (Shadish et al., 2002). Study I was non-experimental and no internal validity inferences can be drawn from our findings. In study II text format was manipulated in a random control trial (RCT) design. In study III hyperlinks and instructional texts were manipulated also in a RCT design. The direct and indirect effect of textual format factor on sourcing was confirmed in study II. In study III distribution of hyperlinks were manipulated. There was no statistically significant effect of distribution on linked claims on other measured variables. However, the extent to which participants accessed the conflicting claims by means of the hyperlinks, positively affected their scores on the CVT. Participants' clicking on hyperlinks had an indirect effect on sourcing performance, mediated by conflict detection. In a mediational model the mediator is presumed to cause the outcome (Jose, 2013). In studies II and III, results of mediational analysis showed that memory for conflicts contributed to sourcing performance. This is in consistence with assumptions drawn from the D-ISC model. Based on our studies, however, we cannot draw internal validity inferences with confidence. For instance, we do not know whether conflict detection precedes sourcing in time on a cognitive process level. It is inherently difficult to obtain social-science variables that behave in a clear causal chain (Jose, 2013). Other forms of data, such as process data, could add to our understanding of whether conflict detection precedes sourcing in time for the individual reader, on a cognitive process level.

Internal validity must be understood as limited to a particular setting, with a particular setting's complex package of components (Shadish et al., 2002). This means that causal inferences in a particular setting cannot be generalized to different, albeit similar, settings.

#### **4. 7 Statistical Validity**

Statistical validity is closely related to internal validity in that both are concerned with study operations (Shadish et al., 2002). Statistical validity is concerned with errors in assessing statistical covariation (Shadish et al., 2002.). Addressing these questions null hypothesis significance testing is most widely used. In an RCT experimental design a test of this hypothesis can be computed by a t-test on treatment group and comparison group. This test is then followed by a statement of the level of probability that differences observed, could be occurred by chance in a population in which no such differences occur. Threats to statistical validity can occur with overreliance on traditions regarding significance testing. Shadish, Cook and Cambell (2002) claim that some scientist wrongly think that non significance imply zero effect size, thereby believing that the null hypothesis is true. They suggest reporting, in

addition to the probability level, effect size and confidence interval. Other threats to statistical validity is low statistical power. With low power, effect sizes will be less precise i. e. have wider confidence intervals. In addition, assumptions of a statistical test may be violated if covariations are inaccurate. This can happen if units of observation are not independent. Educational research studies may often take place in a classroom where students are with their peers, as in our studies I and II. Children in the same class are more related to each other as compared to a randomly drawn sample of school children (Shadish et al., 2002).

#### **4. 8 External Validity**

External validity concerns inferences about the extent to which causal relationships holds over variations in persons, settings, treatments, and outcomes (Shadish et al., 2002, pp.83). There are many threats to external validity inferences. Making external validity inferences based on a particular research setting, may be unwarranted. Nancy Cartwright (2008) warns against unfounded confidence in making generalizing inferences of causality. That is because every research setting comes with a particular set of confounders, which may influence results. Educational settings have many confounders, and it is impossible for researchers to account for all of them. Examples of confounders that may differ in educational, as well as in other settings are: individual characteristics of participants, or type of social setting. Cartwright (2008) describes the problem of generalizing results, as a question of relevance. Shadish, Cook and Cambell (2002) list five reasons why inferences about external validity may be invalid. For example, *interaction of the causal relationship with settings*, is in line with Cartwright's assertions about how different settings will have different confounders. Causal inferences may not hold across different experimental settings. This is named as, *interaction of the causal with units*: An effect with certain kinds of units might not hold if other kinds of units have been studied (Shadish et al., 2002).

This dissertation is based on three studies revolving around the same topics. A main goal was to investigate assumptions drawn from the D-ISC model. There are some variations of units across the three studies. The correlation between memory for conflicts across texts and memory for source to content links was studied with study I. In study II and II we used experimental RCT design to investigate factors that had direct and indirect effects on sourcing. All three studies were framed by the D-ISC model (Braasch et al., 2012). We were interested in the relationship between memory for conflict and memory for source to content links. Reiterating similar research questions, and studying similar topics with different settings, inform us about external validity inferences. Using the term of “relevance” in



accordance with Cartwright (2008), testing similar research questions in different settings, and yielding similar results, informs researchers that questions, models and outcomes are relevant beyond a single study.

#### **4. 9 Ecological Validity**

In quantitative research settings researchers try to disentangle and isolate variables (Cohen, Manion, & Morrison, 2000). Where quantitative researchers try to disentangle, isolate and manipulate variables, qualitative, naturalistic researchers work under different premises. In qualitative, naturalistic research an important premise is to avoid influencing variables that occur naturally in a given setting (Cohen et al., 2000). Ecological validity refers to the relationship between real life situations and research settings. In our studies we used quantitative methodology. Quantitative research settings may seem more contrived and artificial to participants as compared to qualitative naturalistic research. However, any research setting may present variables that would not naturally occur in a real life setting. This means that making inferences about natural settings, based on research, must be done with caution.

Two sets of students, from two different upper secondary schools, participated in study I and II. Undergraduate university students participated in study III. The researchers administered the data collection in all three studies. For the students in upper-secondary school the sessions took place in the student's classrooms. The collection of data presented a break with their usual timetable and agenda, which may have been perceived as a disruption. In other words, we introduced a setting that did not occur naturally. Our pre-rehearsed speech at the beginning, and our efforts to keep neutral and not interact with the students the way a teacher would, added to the artificiality. In study III undergraduate students were led to a room with computers at the university. Data collection with the undergraduate students presented a setting that was different from the lectures or group activities that students were used to. In sum, the research settings in study I, II and II departed from what students might perceive as a natural course of events. Introducing an unusual setting to students, in educational research, may lessen the ecological validity.

When making inferences from a set of data it is crucial that rigorous procedures are observed in making test and text material (Brinkmann & Kvale, 2014). In the first two studies the reading material was identical regarding content of the material and sources, if not in distribution format. In the third study, the four expository texts were enhanced by making the texts longer and adding more conflicts across documents. All sets of documents within study I

and II and III were uniform in terms of lay out, structure of content, readability and length of texts. The risk of such uniformity is that the documents may seem contrived to the participants. This presents a threat to the ecological validity of the study. However, efforts were being made to mimic authentic text material. All information was taken from authentic source material about sun and health issues. It was also important that our conflicting texts were about a topic that is inherently unresolved or controversial. Arguments on each side of the conflicts had counterparts in authentic documents. This enhanced the ecological validity. Examples of controversial scientific topics used in other studies are, for example, the significance of blood cholesterol levels, (Stadtler et al., 2013), and pros and cons regarding the security of nuclear plants (McCrudden et al., 2016). Contrary to study I and II, participants in study III read documents on a mock-up web-site, where the conflicting arguments were connected by hyperlinks. Systematic linking to arguments that refute claims in documents that are first read, is not supported by any of the authentic documents we found on the internet. However, we made an effort of making the web-site mimic a popular scientific page, hence strengthening the ecological validity in the reading situation.

In terms of topic relevance, sun tanning issues may be assumed to be relevant to adolescents and young adults. According to the Norwegian Cancer Association (2009), approximately 50% of young people reported using a sunbed during the last year. Questions of relevance speaks to the issue of ecological validity. It may be assumed that young people would be interested in searching for, and read about sun and health in real life.

For ecological validity to be demonstrated when reporting research, it is important to include and address as many factors of a given setting as possible (Cohen et al., 2000). An issue may be that abiding by ethical tenets like non-traceability, anonymity and non-identifiability, is more difficult when including and addressing more factors (Cohen et al., 2000).

#### **4. 10 Validating the Model**

Validation concerns play a big role in the efforts scientist put into research. Theoretical models of reading processing and comprehension, like the D-ISC model, represent how readers process and represent information they read. A useful model works as a rationale for how research is planned, and it helps in interpreting and communicating results. One function of a theoretical model is that it is explanatory (Goldman et al., 2016). The three studies, that are basis for this dissertation, revolve around investigating the D-ISC model of text discrepancies, and their effect on sourcing strategies. A strength of the thesis is the reiteration of certain research questions. Iterative efforts within a domain can help in evolving and

confirming a theoretical model. (Goldman et al., 2016). This involves building and refining key concepts through multiple encounters with research texts (Golman et al., 2016). All three studies, that are basis for this dissertation, inform us about the D-ISC model, and seem to strengthen the assumptions the model entails. However, a theoretical model is not confirmed once and for all. Laudan and Leplin (1991) hold that the premises for derivation of observable consequences on the basis of theoretical hypothesis, can be argued and refuted. There will always be a question of whether or not one can logically infer correspondence between theory and observations. (Cartwright, 2008). In the final analysis, a scientific theoretical model must be seen as work in progress, and as part of discourse within the scientific community. This also applies to the D-ISC model.

#### **4. 11 Ethical Considerations**

In research ethical considerations and resources can be understood as divided into three categories, *ethical codes*, *informed consent* and *institutional review board* (Shadish et al., 2002). A matrix representing four domains of ethical considerations was presented by Tangen in 2013. The first two domains are useful reminders regarding ethical considerations, when collecting data in school settings. Domain A) is *the need for knowledge*, and Domain B) *the dignity, respect for privacy, autonomy, voice, confidentiality*. For our research we contacted school leaders. In both cases they seemed enthusiastic and curious about our project, and we had little problem in securing their co-operation. We may assume that school leaders' interest in many cases fall in line with researchers need for knowledge in accordance with Domain A (Tangen, 2013). School leaders may want to know more about pedagogical research. In addition, working with a university, may be perceived as a step in leading schools in a contemporary, modern direction. On the other hand, schools are hierarchical institutions. Considerations under Domain B revolve around respect for individuals and informed consent (Tangen, 2013.). Securing informed consent from teachers and students brings up a question of whether their dignity and autonomy are being respected. There may be an element of coercion when principals ask teachers to consent. Next in line are a group of young students. Even if they can choose not to participate, they may experience a degree of group pressure. As it happens, no students refused to participate in our data collections. This raises the question of whether the students felt they had a right to speak up, or had a *voice*, in Tangen's terminology (2008). To address these concerns, entering the classrooms all researchers read the same manuscript. Students were informed about their right not to participate. They were also informed about their anonymity. Students were age above the limit of being able to give

consent. All students identified themselves by giving the four last digits in their cell phone numbers, thus could not be identified by any outside agent. This speaks to the concept of confidentiality in Tangen's matrix.

In the case of the third study, we went around the university, spreading information and recruiting. We spoke to students individually or in small groups. We did not sense group pressure amongst the students, as many refused to participate. Furthermore, they had to meet the researchers at an appointed time by their own volition. It was easy not to keep the appointments for students who may have had second thoughts. In the third study however, an ethical consideration presented itself that we had not encountered in the two first studies. Students made their appointments in an online Doodle. In the Doodle they gave their name and phone number, so we could contact them. This data was deleted after the data collection. The short term storage of personal information, meant that we would have to get approval by an institutional review board. We secured such approval by handling the data in a way that met the requirements of the Personal Data Registers Act. The study was approved by the Norwegian Social Science Data Services.

## **5 Summaries of papers**

### **5.1 Study I: Memory for Textual Conflict Predicts Sourcing when Adolescents Read Multiple Expository Texts.**

The aim of the first study was to investigate the relationship between memory for conflicting content and memory for source to content links. Despite the theoretical and empirical importance of sourcing in MD reading, relatively little is known about textual conditions that encourage sourcing during reading. However, the Discrepancy-Induced Source Comprehension (D-ISC) assumption by Braasch and colleagues (Braasch et al., 2012, Braasch & Bråten, 2017) is basis for a fruitful line of research indicating that the presence of conflicts within or across documents, may increase sourcing performance. Few studies have investigated the role played by conflicting textual information distributed across separate documents, on sourcing performance. In addition, our study expands previous research by comparing the contribution of memory for conflicting information with that of self-reported critical reading strategies. Hence, we were guided by the following research questions: 1) What is the contribution of memory for conflicting information to sourcing, when adolescents read multiple expository texts? 2) What is the contribution of memory for conflicting information, when controlling for critical reading strategies, gender, prior knowledge and interest?

Participants were 86 students from upper secondary school taking a college preparatory course. Students read four expository texts, distributed in four separate documents, about sun and health issues. We divided the four texts into opposing pairs, the pairs consisted of opposing claims, with a total of 8 claims distributed across the four documents. Documents were printed material. Pre-knowledge measurements, measures of topic interest as well as critical reading strategies were measured by self-report instruments. After participants have read the expository texts, memory for conflict was measured, before measuring memory for source to content links. Main findings were that memory for conflicting information uniquely predicts memory for source to content links, when controlling for gender, prior knowledge, interest and critical reading strategies. This study contributes to the empirical evidence of the role of conflict in readers' sourcing performance. Findings are consistent with the D-ISC model (e.g., Braasch et al. 2012), assuming that in constructing a coherent mental model from multiple sources with discrepancies in textual content, readers may shift their strategies by including source information in their mental representation.

## **5. 2 Study II: Direct and Indirect Effects of Textual and Individual Factors on Source-Content Integration When Reading About a Socio-Scientific Issue.**

Study II is a path analytical follow up of study I. The aim of the second study was to test a hypothesized model that specified direct and indirect effects of documents' format factors, textual content factors and individual difference factors on readers' ability to integrate source and content when reading multiple documents. Like study I this study is framed by the D-ISC model (Braasch et al, 2012; Braasch & Bråten, 2017). It is also framed by the documents as entities assumption (Britt, 2013). We were guided by the following research questions: 1) Does memory for conflicting information predict representation of source to content links? 2) Does presentation format affect sourcing directly and/or indirectly? 3) Does individual differences (gender, prior knowledge, interest) directly and/or indirect predict representation of source to content links? Based on theoretical and empirical background analysis on format, textual, and individual factors, we developed a hypothesized model. The fit of the model was tested using data from 140 upper-secondary school students reading documents with conflicting textual claims on the topic of sun exposure and health. Documents were the same as in study I. However, presentation format of the documents was manipulated. Some students read separate documents, and others read the same documents in a single text format. Results showed that the hypothesized model did not fit the data well. We re-evaluated and re-specified the model. Fit indices indicated that this model fit the data well. There was a direct effect of memory for conflicting information on source-content integration. Also there was a direct effect of presentation format, single versus multiple documents, on source to content integration. The individual difference variables of prior knowledge and gender had a direct effect on source to content integration. In addition, presentation format and prior knowledge had indirect effects on source to content integration, mediated by memory for textual conflicts. This study contributes to the understanding of textual and individual difference factors, underlying readers' source to content integration. The study's contribution shows how format, textual and individual factors may not only directly but also indirectly contribute to sourcing in the reading process. The direct and indirect effects of format factors is consistent with the assumption that clear boundaries between multiple resources may contribute to sourcing performance, as compared to presentation of documents in single text formats (Britt et al., 2013). The findings that memory for conflicting information mediated the indirect effect of presentation format, is unique to this study. This finding highlights the importance of considering the D-ISC model (Braasch et al., 2012; Braasch & Bråten, 2017) in juxtaposition with the documents as entities assumption (Britt et al., 2013).

### **5. 3 Study III: Investigating Conflict Detection and Sourcing in a Multiple Document Hypertext Environment.**

Study I showed that conflict detection was a unique predictor of source to content integration, after controlling for prior knowledge, interest and critical reading strategies. A follow up study, study II, showed that conflict detection mediated the effect of presentation format on source to content integration when controlling for other cognitive and motivational variables. Previous research framed by the D-ISC model (e.g., Braasch et al., 2012) has varied with respect to the format as well as the genre of the reading material. However, to the best of our knowledge, no prior study has presented multiple conflicting documents in a digital hypertext environment. In the third study we created a reading environment where readers could access conflicting claims in another document by clicking on links embedded within the document currently read. Study III was guided by the following research questions: 1) Does memory for conflicting information predict representation of source to content links? 2) Do hyperlinks embedded in currently read documents, and leading to an opposing claim in another document, facilitate conflict detection and source integration? 3) Is there a relationship between prompting condition and participants' selection of hyperlinks?

The participants were 85 undergraduate students, of which 77 were enrolled in bachelor programs and 8 in master programs. We created a mock-up scientific web-site containing a modified version of the text material used in study I and II. We increased the number of conflicts to have a large enough number of claims to manipulate placing of the hyperlinks. In sum the four documents contained 16 claims, four within each document. Results showed that prompting conditions were not related to any of the variables. The number of times participants clicked on the hyperlinks were positively correlated to scores on the conflict verification task. Furthermore, the number of times students clicked was only positively correlated to the CVT with items referring to claims that were hyperlinked in the texts, and not to those referring to claims that were not linked. The number of times participants clicked on linked claims were also positively correlated to scores on the source-content integration task. Finally, a bootstrapped analysis showed a positively statistically significant indirect effect of clicking on linked claims mediated by conflict detection. Finding that conflict detection may mediate the effect of clicking on linked claims on source to content integration is consistent with the D-ISC model (Braasch et al., 2012; Braasch & Bråten, 2017). Accessing conflicting claims via hyperlinks may facilitate the co-activation of such claims in working memory. To restore coherence, attention to conflict may lead to attention to the source

information linked to the documents containing the respective claims. Showing that a hypertext reading context with multiple documents, can be construed in a way that facilitates conflict detection as well as sourcing, extends our understanding of the applicability of the D-ISC model, from a more simplistic reading context with printed material, to a digital, albeit simplistic, reading environment.



	<b>Stang Lund, Bråten, Brante, Strømsø (2017). Reading Psychology</b>	<b>Stang Lund, Bråten, Brandmo, Brante, Strømsø (2019). Reading and Writing</b>	<b>Delgado, Stang Lund, Salmerón, Bråten in press. Reading and Writing</b>
<b>Topic of study</b>	Relationship between memory for conflicting content and memory for source to content links.	Examining variables predicting construction of source to content links.	Examining variables predicting construction of source to content links.
<b>Participants</b>	86 students (79.1% female, 20.9% male) from upper secondary school. College preparatory courses.	140 (36.4% female, 63.6% male) upper secondary school children on college preparatory courses.	85 students (64 females, 21 males), 77 enrolled in bachelor programs and 8 in master programs.
<b>Main theoretical frameworks</b>	D-ISC	D-ISC Documents Model	D-ISC
<b>Research questions</b>	What is the contribution of memory for conflicting information to sourcing when adolescents read multiple expository texts, when controlling for critical reading strategies, gender, prior knowledge and interest?	What is the contribution of memory for conflicting information to sourcing when adolescents read multiple expository texts? What are the indirect and/or direct effects of presentation format, and individual differences factors on sourcing?	What is the contribution of memory for conflicting information to sourcing when adolescents read multiple expository texts? What are the effects of clicking hyperlinks on conflict recognition and sourcing? What are the effects of prompting conditions on participants clicking on hyperlinks?
<b>Learning materials</b>	Four separate expository texts, with conflicting information, about sun exposure and health. Prints.	Expository texts, with conflicting information, about sun exposure and health. Presentation formats: multiple prints or single prints.	Four expository texts with conflicting information, distributed on hypertext web sites.
<b>Dependent variable</b>	Memory for source to content links.	Memory for source to content links.	Memory for source to content links.
<b>Statistical models of analysis</b>	Descriptive statistics. Correlation. Hierarchical regression analysis.	Correlations. Descriptive statistics. Path analysis.	Correlations. Descriptive statistics. Mediation analysis.
<b>Main findings</b>	Memory for conflicting information uniquely predicts memory for sources, when controlling for gender, prior knowledge, interest and critical reading strategies.	Direct effect of memory for conflicting information on source to content integration. Direct and indirect effects of format and prior knowledge on sourcing. Direct effect of gender on sourcing.	No effect of prompting condition. Number of times participants clicked, positively correlated to scores on linked claims on conflict verification task. Number of times participants clicked, had a direct and indirect effect on sourcing.

Table 1 overview of studies



## 6 Discussion

This doctoral thesis is built on recognizing the importance of strategic sourcing behavior, when reading multiple documents. Sourcing involves attending to explicit markers of source reliability and trustworthiness (Cho, et al., 2018). These markers can be author's credentials or publication venue. Source information is deemed as necessary in making full meaning of documents' content (e.g., Wineburg 1991). Strategic use of source information also involves comparing sources and linking documents through source to source links, which is an important prerequisite for building an integrated cognitive representation of a set of documents (e.g., Britt et al, 1999; Britt et al., 2013,). The Documents Model framework explains how integrating semantic content, or constructing a coherent mental model of the situation or issue described in a set of documents, requires building an inter-text model. An inter-text model is construed partly by way of paying attention to source information and representing source to content links. Source information is presumed to function as an organizational component. The thesis is also built on assumptions derived from the D-ISC model (e.g., Braasch et al., 2012; Bråten & Braasch, 2017). The main assumption of the D-ISC model is that when a set of documents, dealing with the same topic, have discrepant or conflicting claims, it may affect readers' behaviors towards paying attention to sources. The aim of the thesis is contributing to a better understanding of the textual, format and individual factors that influence MD reading behavior. There is a special focus on how readers' attention to conflicting claims affects use of sourcing strategies in learners. The studies extended over three different reading situations, with three separate groups of participants.

In study I, results show that memory for conflicting textual information uniquely predicts source to content links when adolescents read multiple expository texts on a scientific (i.e., health) issue. The forced order multiple regression analysis in study I, showed that memory for conflicts across a set of multiple documents statistically significantly predicted memory for source to content links over and above the other variables we entered into the regression. The first study provides additional empirical evidence to support the claim that representing conflicting content information may predict sourcing performance. The applicability of the D-ISC model is with study I, extended to adolescents reading multiple expository texts on a controversial health issue. Investigating the D-ISC model with upper-secondary school students reading texts of an expository genre, added to earlier investigation of the model.

Study II extends study I. We increased the number of participant and used a RTC design to investigate the contribution of document format on reading behaviors. The path analysis

shows indirect and direct effects of the format factor on source to content integration. Consistent with prior research (e.g., Britt & Aglinskas, 2002, Nokes et al., 2007), our study shows that the format of separately distributed documents improves sourcing performance, compared to when reading the same documents in a single text distribution. Moreover, multiple document distribution format had an indirect effect on sourcing performance, mediated through memory for textual conflict. In their study, Statdler and colleagues (2013) found that when readers encounter discrepant views across a set of separately distributed documents, documents being distinct facilitated representations of memory for conflict, compared to when documents were distributed on a single paper. Unique to our study, however, is finding that readers' memory for textual conflicts, in turn, contributed to participants' sourcing performance, thus had a mediating effect. The direct and indirect effects of presentation format on source to content integration, mediated by memory for conflict theoretically highlights the importance of the D-ISC model (Braasch & Bråten, 2017) in juxtaposition with the documents-as-entities assumption (Britt et al., 2013). Our study shows that separate distribution of MDs can facilitate conflict detection, as well as sourcing. The results from the classroom intervention study by Nokes and colleagues (2007) are in line with our second study. The classroom study showed how using separate documents as learning material, can improve content learning, as well as facilitate the teaching and learning of reading strategies, such as sourcing (Nokes et al., 2007). This may challenge the extensive use of traditional textbooks in educational settings. Textbooks offer coherent representations, if they are well written. It is still important to remember that not all learners benefit from learning in less-structured reading environments. Separate documents may be perceived as less coherent than single text presentations. Some learners benefit from coherent reading material (McNamara et al., 1996). A traditional textbook, as well as teachers explaining the material and providing coherence, can be important factors in supporting new learners, and learners being introduced to new topics.

In regards to individual differences, the direct and indirect effect of prior knowledge on sourcing was confirmed in study II. Finding that prior knowledge may uniquely predict sourcing is consistent with previous research (e.g., Braasch et al., 2014). The finding that prior knowledge is associated with readers' representation of textual conflicts is corroborated by previous research (e.g., Trevors, Feyzi-Behnagh, Azevedo, & Bouchet, 2016). However, the finding that level of prior knowledge indirectly contributes to readers' sourcing is unique to this study. It is possible that the potential lack of coherence in MD reading demand more

from readers in terms of prior knowledge, than single documents that are intentionally authored to be more coherent (Barzilai & Strømsø, 2018). Conflicting claims across MDs adds to the incoherence. The assumption that prior knowledge affects learning from incoherent texts is consistent with McNamara and colleagues (1996) classic study. Participants' prior knowledge influenced the course of reading, in our study, in that it affected their abilities to represent conflicts, which in turn influenced their use of sourcing strategies. There may be several reasons for this. For example, it is possible that readers with high prior-knowledge, previously had read several documents about the topic sun and health. Therefore, they may have already been familiar with conflicting accounts concerning the sun and health issue, and recognized the claims in the conflict verification task. Re-reading claims in the CVT, is different from reading them for the first time. It is reasonable to assume that re-read claims are easier to remember. The role of prior knowledge in MD reading may suggest further refinement of models trying to capture the nature of MD reading.

The gender variable was found to directly, but not indirectly, predict sourcing behavior, when controlling for all other variables. This is in accordance with earlier findings that upper-secondary females outperform males in reading. According to international reading assessments, girls typically outperform boys (OECD, 2016) in reading skills. However, it is not altogether clear that these findings translate to 21st century MD reading (Barzilai & Strømsø, 2018), even if our finding suggest that females outperform their male counterparts in sourcing performance. A more systematic study of the role of gender in MD strategic reading and comprehension may be called for.

In study II, we found limited support for the assumption that interest both directly and indirectly contributed to sourcing performance. In accordance with the CAEM model (List & Alexander, 2017) topic interest was found to affects readers' default stances along the dimension of affective engagement. Readers' levels of affective engagement, in combination with behavioral skills and habits regarding text evaluation should, according to the model, determine MD reading behavior, such as integration and sourcing. This would entail that topic interest contributes to sourcing performance. In our study, it is possible that interest correlated with other variables that were better predictors of conflict verification and sourcing. Investigating how affective engagement and motivational factors, along with behavioral strategic cognitive skills, affect MD reading processes and outcome is an interesting prospect.

In study III we extended study I and II by creating a digital reading environment. Acknowledging that much MD reading in the 21st century takes place in digital reading settings, we departed from distributing MDs in print and created a mock-up scientific, digital web site. As hypothesized, results showed that accessing conflicting claims in another document by clicking on hyperlinks, embedded in a currently read document, contributed to readers' conflict detection. In turn, mediated by memory for conflicts, clicking on hyperlinks contributed to readers' sourcing performance. These findings are consistent with the assumptions of the D-ISC model (e.g. Braasch et al., 2012; Braasch & Bråten, 2017). An explanation of how the D-ISC model worked in a hypertext environment is the way we presented two opposing claims simultaneously by way of pop-up balloons. This may have co-activated conflict representation in working memory, which in turn may have contributed to sourcing. Our study extends previous studies by suggesting that the D-ISC model can be confirmed in a digital hypertext reading environment. Furthermore, it suggests that readers' memory for conflicts in texts, as well as use of sourcing strategies can be influenced by what sort of digital reading environment they are presented with. We created a particular type of hypertext reading environment, presenting opposing claims simultaneously with pop-up balloons. However, the way our hypertexts were construed is most likely unique to our study. We did not find support for this form of hypertext digital design, in any authentic hypertext environments on the internet. This limits the generalizability of the study. In fact, authentic hypertext reading environments may just as likely promote fragmentation as integration (e.g., DeStefano & LeFevre, 2007; Niederhauser, Reynolds, Salmen, & Skolmoski, 2000). Hyperlinks may lead readers astray and away from the originally read document. In our reading environment the presently read document did not disappear for the reader when they accessed claims in an opposing document. In explaining the results, we cannot rule out the possibility that beneficial aspects of the pop-up balloons, at least partly, were due to the fact that participants by clicking the hyperlinks read the linked conflicting claims more times. This means that we cannot say with certainty that it was the simultaneous presentation of conflicting claims that benefited the readers. Future researchers should control for the number of times participants read conflicting claims that are hyperlinked, and conflicting claims not hyperlinked in this way.

Our manipulation of the task instruction did not produce the expected results. While prior studies have demonstrated that task instructions may influence reading behavior (e.g., Bråten, Gil, & Strømsø, 2011), receiving a stronger prompting condition in our study, did not increase

the likelihood of participants clicking on hyperlinks. One explanation for this may be that the difference between the presumed “weak” task instruction and the presumed “stronger” instruction were not sufficiently pronounced.

The investigation of the D-ISC model in a digital environment confirmed the hypothesis that conflict representation promotes sourcing performance. Finding that properties of the digital environment can affect source-content integration, mediated by conflict detection, opens up new realms of possibilities. Studying how strategic reading can be supported in a digital reading environment, may potentially benefit readers navigating the complexities of digital reading in the 21st century.

Investigating assumptions in three different settings creates additional value. The three studies have common focus, namely investigating individual, format, and textual variables’ relationship to readers’ source to content integration. A central theme in all three studies is investigating the role of conflicting claims across texts. The studies in the thesis all confirm relationships between memory for conflict and source to content integration in accordance with the D-ISC model (e.g., Brasch et al., 2012, Bråten & Braasch, 2017). The studies differed in terms of document’s format, settings, participants, co-variables and statistical models of analysis. Shadish, Cook and Cambell (2002) address the question of whether results found in research hold over variations in persons, settings, treatments and outcomes. Seeing that hypothesis framed by the D-ISC model were confirmed in all three studies, informs us about external validity inferences (Shadish et al., 2002). Our research must also be seen in conjunction with previous research that explores the D-ISC model. Reiterating questions within the research community (Goldman et al., 2016), with a variation of settings and treatments, inform us about strengths and limitations of our assumptions and of our models

## **7 Limitations and Future Research**

This thesis, with its three different research settings, adds to the empirical support for the D-ISC model (e.g., Braasch et al., 2012). However, the studies do not come without a set of limitations. One concern is regarding the relative homogeneity of participants. Albeit the participants came from three different educational institutions and varied somewhat in terms of age, participants were relatively homogenous in terms of socio-economic background. Most participants came from a middle-class back-ground and all participants were involved in studies indicating an academically focused trajectory. Cartwright (2008) discusses external validity inferences as a question of relevance. Doing research with participants from a certain social stratification brings up a question of whether results are relevant to other groups of the overall population. Future research could sample participants from other parts of the population for further studies about the role of conflict in strategic reading behaviors. Studying younger children, older people and/or people not involved in an educational setting, might give different results.

A second concern regards the relative homogeneity of reading material. We addressed these questions by varying document distribution, so that students in study II read either single or separate MDs in a between-participants design. In the third study reading material was presented on a digital platform. In addition, texts were longer and more complicated in study III, appropriate for the age and educational level of the participants. However, the topic of sun and health was the same in all three studies. Prior studies have used other scientifically controversies as basis for the construction of the reading material. Examples of other topics are possible adverse effects of artificial sweeteners (Strømsø et al., 2017) and climate change (McCrudden et al., 2016). Future studies could perhaps depart from the topic of science. There are several social, economic and political questions in society today that do not have clear-cut definitive answers. Investigating strategic reading with sources that are presented as having political agendas could be interesting. Taxation or inner city traffic regulations, could be topics where different politicians are expected to have opposing views. Documents with sources that are expected to have a certain political agenda, can lead to authors being perceived as more personified. This may increase the likelihood of documents being experienced as entities, in accordance with the documents as entities assumptions (Britt et al., 2013). Using topics that are political could also bring into question participants' prior beliefs and attitudes. Maier and Richter's (2013) study demonstrated how prior beliefs affect sourcing.



Ecological validity was of some concern in all three studies. Doing quantitative research in educational science involves an amount of trade-off, or balancing act. Ideally we want to investigate factors that are relevant to a natural educational environment. However, when making inferences from a set of data it is crucial that rigorous procedures are observed in making test and text material (Brinkmann & Kvale, 2014). In quantitative research settings researchers try to disentangle and isolate variables, and there will be a degree of control, and manipulation of variables (Cohen et al., 2000). It would be interesting to investigate conflicting texts and their relation to sourcing in environments less constrained by rigorous research procedures. Further confirmation of the D-ISC model could involve using discrepant reading material in naturally occurring classrooms activities. This could involve integrating discrepant texts over time, aligned with the curriculum. Developing a reward system crediting use of MD strategies could raise the stake for students, hopefully encouraging students to put their best efforts into developing sourcing skills.

Premises for making internal validity inferences based on the studies, are open for discussion. The first study is merely correlational and we make no claim about causality based on data collected for purpose of analysis in study I. In study II and III we used statistical models with mediators. In a mediational model the mediator is presumed to cause the outcome (Jose, 2013). Seeing that cognitive representation of conflicts across documents in readers were mediating variables in study II and III, it is tempting to claim that the variable of source to content integration was affected by the variable of the level of conflict representation. However, Jose (2013) warns against using causal language with results from concurrent data. There is a problem with making causal direction claims in study II and III based on the mediators, since the data are collected at one time-point. On the one hand, we could argue that we had the advantage of temporal placement of variables (Jose, 2013). The conflict verification test was taken by participants before the measurements of source to content integration. However, the D-ISC model is based on the assumption that conflict detection strengthens attention to sources during reading. It is unclear whether based on the post-reading measurements it is feasible to claim that participants represented a particular conflict, while reading, before paying attention to the author of the claim. It is important to note that an overwhelming amount of research demonstrates correlational relationships between conflict detection and source to content integration. This could be interpreted as a causal chain where conflict detection precedes sourcing. Another interpretation is understanding cognitive processes underlying the D-ISC model as cyclic. Understanding the D-ISC model as cyclic

might entail that conflict recognition increases attention to sources which again entails increased attention to more conflicts in a continuous cycle. In study II and III we manipulated variables in a RCT design. Results showed that format and clicking on hyperlinks had direct and indirect effect on sourcing, mediated by conflict detection. According to Jose (2013), within an experimental paradigm there is the advantage of temporal placement of variables. With the manipulated variables causal language may be justified. Future research should address the processes that underlie the D-ISC model, as well as conditions that affects readers' recognition of conflicts and discrepancies in texts. Collecting process data with for example think aloud studies (Kammerer et al., 2016) or eye tracking studies (van Strien et al., 2016) could give insight to underlying processes of the D-ISC model.

## 8 Pedagogical Implications

As mentioned at the beginning of the extended abstract, *The Norwegian Ministry of Education and Research* will implement a new national curriculum (Fagfornyelsen, 2018) over the next two years. In accordance with the last curriculum L06, the new curriculum upholds a focus on developing critical thinking and source evaluation strategies, as parts of teaching reading literacy. The new curriculum specifies how students should know how to critically evaluate different sources of knowledge, learn how to think critically about the origins of sources, and understand how knowledge is created. The specifications in national curriculums, both here in Norway and abroad, reflect 21st century reading skills in a digital age. Having a focus on source information, and employing a critical approach to knowledge resources, are necessary parts of reading literacy, given the plethora of, and variations in, documents on the Internet. Indeed, digital reading has for some time been an integral part of many classrooms' practices. The intentions upheld by governmental steering documents are laudable, but raise questions of whether teachers have the knowledge and resources to implement governmental intentions and goals. Teaching reading literacy involves more than teaching reading strategies. In addition, students must also learn the clusters of types of knowledge that are discipline-specific (Goldman et al, 2016). An important question is, how teachers may translate intentions presented in the curriculums, into practices and tasks fitting a wide range of students, in terms of age and abilities.

Accessing and assessing documents on the internet based on trustworthiness and relevance, is difficult for many students (Walraven et al., 2012). Making coherent representations of MDs, especially when those documents have discrepancies in textual content, can be a challenge for even advanced readers (Bråten & Braasch, 2018). When teachers give non-specific tasks and tell students to use the internet at large to search for knowledge resources, the student work is often based on "cut and paste" strategies (Walraven et al., 2012). The finished products become hard for teachers to grade, because it is near to impossible assessing what the student have actually learned by putting together odd bits and pieces of information found on the Internet. This makes it difficult for teachers to guide students towards further developments. Studies show that students often do not have skills to maneuver strategically in a multi-textual reading environment (e.g., Wineburg, 1991; Goldman et al., 2012). Britt and Aglinskias (2002) found that even students at a college level do not spontaneously source when reading MDs. A study that underlines how even experienced readers may disregard source information, has been carried out by Bråten, Strømsø and Andreassen (2015). In this study, participants were

259 undergraduates. Irrespective of text manipulations regarding source salience, students generally overlooked source information, relying on their own experiences and opinions instead. Hence, it seems important to teach students how to routinely use source information when reading, before they reach the level of college.

Research within the disciplinary domain of MD reading literacy, have included intervention studies demonstrating that MD reading strategies can be taught to different groups of students. In 2017, Brante and Strømsø published a review including 18 intervention studies in educational settings, with a focus on sourcing. For example, Braasch and colleagues (2013) improved sourcing skills in upper secondary school students by showing the intervention group “contrasting cases”. A presentation of an invented student’s purposeful source evaluation as a contrast to another student case of less purposeful document evaluation, taught participants how to source by example. This intervention took only 60 minutes, which demonstrates that many readers at this educational level willingly pick up sourcing strategies if guided. The study had no follow up and it was impossible to conclude whether students transferred their newly acquired skills to other academic tasks. Nokes, Dole and Hacker (2007) did a three-week intervention in history classes, with students aged 16 and 17 years. Findings highlighted the importance of reading multiple documents, as opposed to traditional text-books, to facilitate the use of MD reading strategies like sourcing, corroboration and contextualization (Wineburg, 1991). The juxta-positioning of the documents as entities assumption (Britt et al., 2013) with teaching student’s MD strategic reading, increased both content learning and use of strategies. These results are in line with what we found in study II in this thesis, giving support to the assumption that boundaries between documents influences strategic reading behavior. Encouraging reading skills in students can also be done in a digital reading environment. Britt and Aglinskias (2002) developed a computer based tutorial system. Studies showed that using the “Sourcer’s Apprentice” in place of regular classroom activities centered around a text-book, with both activities being based on the same content, improved sourcing, corroboration and contextualization on a transfer test. In addition, the group who had used the Sourcer’s Apprentice wrote more integrated essays and referenced more sources in their writing. The studies, by Nokes and colleagues and Britt and Aglinskias, show that teaching strategic MD reading, does not mean that there is less room for content learning.

This dissertation suggests that students can benefit from classroom activities involving conflicting claims across a set of documents. This is supported by empirical as well as theoretical frameworks. The D-ISC (e.g., Braasch et al., 2012, Braasch & Bråten, 2017)

model, which is a micro model within the DMF framework (e.g., Rouet, 2006, Britt et al., 2013) are theoretical frameworks of this dissertation. The D-ISC model is based on the assumption that discrepant text material promotes use of sourcing strategies. Our studies did not have outcome variables investigating deeper versus superficial learning. It is still worth mentioning that one of the assumptions of the D-ISC, model is that reconciling discrepant texts will contribute to deeper learning. This has pedagogical implications. Making students work with discrepant text material, may not only affect memory for sources, but also have an effect on for example, essay writing. Citing more sources in summaries (Braasch et al., 2012) and being able to explain claims from different authors when writing essays, are examples of improvements in writing for students, after the reading of discrepant text material (Barzilai & Eshet-Alkalai, 2015). Other researchers also discuss how learning in an ambiguous environment can improve readers deeper learning (Spiro, 1988; McNamara et al., 1996). However, learning in an ill structured environment demands more activity and effort on part of the reader. In addition, individual differences in prior knowledge may affect readers' abilities to make the necessary inferences when reading incoherent material. Less experienced readers, or readers who are less knowledgeable about certain topics, benefit from coherent texts (McNamara et al., 1996). However, gradually exposing students to conflicting MDs, are a necessary part of learning within the domain of the new literacies. It is impossible to avoid topics that are intrinsically ambiguous in a multi-textual reading society. Students need to gradually learn to manage ambiguity.

Reading digitally does not necessarily fully replace reading printed material. Singer and Alexander (2017) found in a systematic review some advantages for print over digital reading. The review suggests, for example, that there exists some potential for comprehension decrement when reading longer texts digitally rather than in print. However, Singer and Alexander (2017) hold that differences between reading digitally and reading printed material is under investigated. Reading printed material does not however need to be limited to the traditional textbook. Our studies suggest that distributing separate documents with discrepancies across printed texts can play a role in tutoring children how to reconcile conflicts and use sourcing strategies. Uniform, printed and simple MD material can work as reading material in scaffolding processes, moving students towards navigating conflicting documents in authentic digital reading environments. Reading traditional printed books, including the former ubiquitous text-book, may still be a good idea, especially for new readers. Some young readers may enjoy the haptic experience of touching a solid book.

There are reasons to believe that many students lack the skills and the discipline to search for and integrate documents to help them solve school work activities (Walraven et al., 2012). This means that teachers need to supervise students' activities on the internet. It means for teachers to take back some of the role as "gate-keepers", standing vigilantly between what students read and the textual world at large. Students vary in their level of reading skills, ideally teachers can control and vary the distribution of texts, digitally and printed. Teachers can regulate the type and format of texts, to suit the individual student, and the task at hand.

Digital reading will play a huge role in educational systems, in the foreseeable future.

Pedagogical platforms can be designed to work as scaffolds for less experienced readers, teaching them how to work strategically with MDs. Today many students are distracted by "the bells and whistles" (Singer & Alexander, 2017) found on the internet. Irrelevant commercial hyperlinks and other affordances, can lead inexperienced readers astray. Such features can be regulated, and digital sites can be made for educational purposes helping in tutoring learners in strategic MD reading. Britt and Aglinskaskas', (2002) Sourcer's Apprentice is one example of a digital reading platform created for pedagogical purposes. In our third study, we designed a site in accordance with assumptions derived from the D-ISC model. Links presenting pop-up balloons were created for the purpose of making students notice conflicts, the number of times they clicked links that lead to opposing claims, predicted participants' level of sourcing. The design shows how digital presentation format can increase the likelihood of conflict detection and sourcing. Other tutorial designs could be introduced, fitting the discipline, class or age group, as well as the individual reader.

During the course of the past few decades, possibilities of accessing information have improved beyond measure. There are few gate-keepers standing between documents good, bad, and everything in between, and readers. However, with added possibilities come increasing demands for readers who want to make purposeful use of affordances in a multi-textual reading universe. In many ways, complexities and affordances of the 21st century reading society, reflect the multitude of possibilities and demands that come as a result of how interactions between nations have increased. Various performances of citizenship have changed due to globalization. Increasingly, it has become harder to stay sufficiently informed to influence democracies in purposeful ways. Ideally, we want as large a proportion of citizens as possible to be involved in, and informed about societies. Accessing documents, thinking critically about relationships between sources and documents' content, as well as reconciling informational discrepancies, can be taught and learned. Teaching multiple

documents reading strategies can help learners in developing skills, crucial to navigate the internet as informed citizens, in modern societies. Preparing students for the complexities of a modern reading society, plays a part in the kind of legacy we want to leave behind as educators.

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## Direct and indirect effects of textual and individual factors on source-content integration when reading about a socio-scientific issue

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**Abstract** The purpose of this study was to test a hypothesized model that specified direct and indirect effects of textual and individual factors on readers' ability to integrate information about sources and content when reading multiple conflicting texts on a controversial socio-scientific issue. Using a path analytic approach with a sample of 140 Norwegian upper secondary school students, it was found that the textual factor of presentation format, specifically whether they read about the conflicting issue in multiple texts or in a single text, affected source-content integration directly as well as indirectly through memory for textual conflicts. Thus, compared to interacting with a single text, interacting with multiple texts improved students' sourcing performance directly as well as indirectly. Further, the individual factors of prior knowledge and gender affected source-content integration directly, with prior knowledge also having an indirect effect that was mediated by memory for textual conflicts. Specifically, students with higher prior knowledge and girls were likely to display better sourcing performance than were students with lower prior knowledge and boys, and prior knowledge also had an indirect positive effect on sourcing via memory for textual conflicts. Theoretical as well as educational implications of the findings are discussed.

**Keywords** Multiple texts · Presentation format · Individual differences · Textual conflicts · Sourcing

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## Introduction

During this century, learning with multiple sources has attracted increased interest and attention from researchers in learning and literacy (Bråten & Braasch, 2017; List & Alexander, 2017a). Given the exponential growth of information resources almost instantaneously available to learners during this period (Lawless & Schrader, 2008), this is no surprise. Because these resources vary greatly in terms of quality and accuracy, many researchers have become particularly concerned that the learning and literacy landscape of the 21st century requires that learners pay attention to the origin, context, and purpose of information, so that they can critically evaluate the trustworthiness of information in light of the sources (Bråten, Stadler, & Salmerón, 2018; Britt, Rouet, & Braasch, 2013; Leu, Kinzer, Coiro, Castek, & Henry, 2013; Goldman, 2004). This is no easy task, however, and it presupposes that learners tag key information for its source, that is, include source-content links in their mental representations of the information resources (Britt, Perfetti, Sandak, & Rouet, 1999; Rouet, 2006). And, although students have been shown to typically disregard source information and pay attention only to the content of information resources (e.g., Bråten, Strømsø, & Andreassen, 2016; Britt & Aglinskis, 2002; Kiili, Laurinen, & Marttunen, 2008; von der Mühlen, Richter, Schmid, Schmidt, & Berthold, 2016), the extent that they construct source-content links in multiple source contexts may vary with textual as well as individual difference factors (Britt & Rouet, 2012; List & Alexander, 2017b; Rouet & Britt, 2011; Rouet, Britt, & Durik, 2017). This article uniquely contributes to the burgeoning literature in this area by addressing direct and indirect relationships between textual and individual difference factors on the one hand and students' source-content integration on the other.

## Theoretical and empirical background

Our study is framed by the Discrepancy-Induced Source Comprehension (D-ISC) model of Braasch and colleagues (Braasch & Bråten, 2017; Braasch, Rouet, Vibert, & Britt, 2012) and the documents-as-entities assumption of Britt and colleagues (Britt et al., 2013). Moreover, focusing on textual information resources that present conflicting views by different sources on the same issue, we define *sources* as information about individuals and organizations that create and publish textual content, including information about when, where, and for what purpose the content is created and published (Bråten & Braasch, 2018). Also following Bråten and Braasch (2018), we define *sourcing* as attending to, representing, evaluating, and using available or accessible information about the sources of textual content, for example about the author or publisher. The aspect of sourcing that is the main focus of attention in the current study concerns the representation of source-content links.

According to the D-ISC model (Braasch & Bråten, 2017; Braasch et al., 2012), when learners encounter conflicting views on the same issue that are presented by different sources, their attention to “who says what” will increase, resulting in source-content links being included in their mental representations of the

information resources. This tenet is consistent with a basic idea within text comprehension research, positing that text comprehension involves the construction of a coherent mental representation during reading (McNamara & Magliano, 2009). Such coherence may be particularly challenging to achieve, however, when different sources present conflicting views on the same issue (van den Broek & Kendeou, 2015). In those contexts, learners are therefore prone to experience a break in situational coherence that they try to resolve by engaging in effortful strategic processing (Graesser, Singer, & Trabasso, 1994). According to the D-ISC model (Braasch & Bråten, 2017; Braasch et al., 2012), this processing is likely to involve linking conflicting information to the respective sources and using the resulting representational structure to restore coherence (e.g., by qualifying conflicting views by associated source information). Thus, while noticing or detecting textual conflicts may promote the construction of source-content links, such links may, in turn, help learners understand and resolve those conflicts (Bråten, Anmarkrud, Brandmo, & Strømsø, 2014; Perfetti, Rouet, & Britt, 1999; Stadtler & Bromme, 2014).

The effect of textual conflicts on sourcing may be nuanced by the salience of the boundaries that exist between the textual information resources. This qualification of the D-ISC model is consistent with the documents-as-entities assumption set forth by Britt et al. (2013). As highlighted by these authors, textual information resources (i.e., documents) are social artifacts written by particular authors, published in particular outlets at particular points of time, and having particular purposes. The extent to which learners experience documents as such entities, and thereby engage in sourcing, will depend on the salience or distinctiveness of the boundaries between the documents, however (Britt et al., 2013). For example, when learners interact with separate documents that have clearly demarcated boundaries and source information prominently displayed at the beginning of each document, it is more likely that they pay attention to sources and construct source-content links than when they interact with documents where the boundaries are blurred or obscured, such as when several documents are included in the same booklet or web page. Accordingly, Britt et al. (2013) predicted that learners will be less likely to engage in sourcing when they read only a single text on a particular issue, compared to multiple texts. Presumably, this will also be the case when exactly the same conflicting views and the same source information are presented in a single text as in multiple texts (Britt & Aglinskas, 2002).

Finally, it is consistent with both the D-ISC model and the documents-as-entities assumption that not only textual but also individual difference factors play a role in learners' sourcing performance when dealing with multiple conflicting views on the same topic. In particular, Britt, Rouet, and colleagues (Britt et al., 2013; Rouet & Britt, 2011; Rouet et al., 2017) have highlighted that learners' prior knowledge is an important individual difference variable, which presumably influences learners' noticing of conflicts between different perspectives on the same issue, as well as their ability to construct links between key content information and the respective sources. Recently, List and Alexander (2017b), in their Cognitive Affective Engagement Model (CAEM) of multiple source use, argued that learners' warm, motivated engagement needs to be taken more into account in research on multiple

source use. In particular, these authors highlighted the potential role of learners' topic interest in the construction of coherent mental representations from multiple conflicting sources, with such mental representations presumably including source-content links as organizational elements (Braasch & Bråten, 2017).

Regarding empirical support for the D-ISC model, a range of studies has confirmed that when learners encounter conflicting textual claims from different sources, they also become more vigilant regarding those sources and, accordingly, pay more attention to "who says what", compared to when they encounter consistent claims on the same issue (for reviews, see Braasch & Bråten, 2017; Bråten & Braasch, 2018). For example, Kammerer, Kalbfell, and Gerjets (2016) found that undergraduates who read conflicting information about a health-related issue on two web pages paid more attention to source information and made more evaluative judgments about the sources than did participants who read consistent information about the same issue. In addition, participants who had read conflicting information referred more to the sources when making recommendations on the issue and discriminated better between more and less trustworthy sources.

In accordance with the documents-as-entities assumption, some research also indicates that the effect of encountering conflicting views on sourcing may depend on the salience of the boundaries between documents. Thus, Britt and Aglinskas (2002, Experiment 3) had high-school students read about the same historical controversy in seven distinct documents or in a single textbook-like chapter where the boundaries between the documents were less clear. Importantly, however, the two presentation formats conveyed exactly the same conflicting views and the same information about the sources of those views, with the conflicting views and their respective sources distributed across separate documents and embedded within the textbook-like chapter, respectively. In brief, Britt and Aglinskas (2002) found that students who interacted with distinct documents were more able to identify and evaluate sources on a transfer test than were those who read the textbook-like chapter. Moreover, the former group of students was found to write essays on the historical controversy that integrated more source citations into the content of their essays.

In a more recent, complementary study, Stadtler, Scharrer, Brummernhenrich, and Bromme (2013) compared two groups of undergraduates that were presented with the same conflicting views on a controversial medical issue either on four distinct websites or on one single website. In this study, it was found that those who read the conflicting information on distinct websites displayed better memory for the textual conflicts and also wrote more balanced essays that took conflicting perspectives on the issue into account.

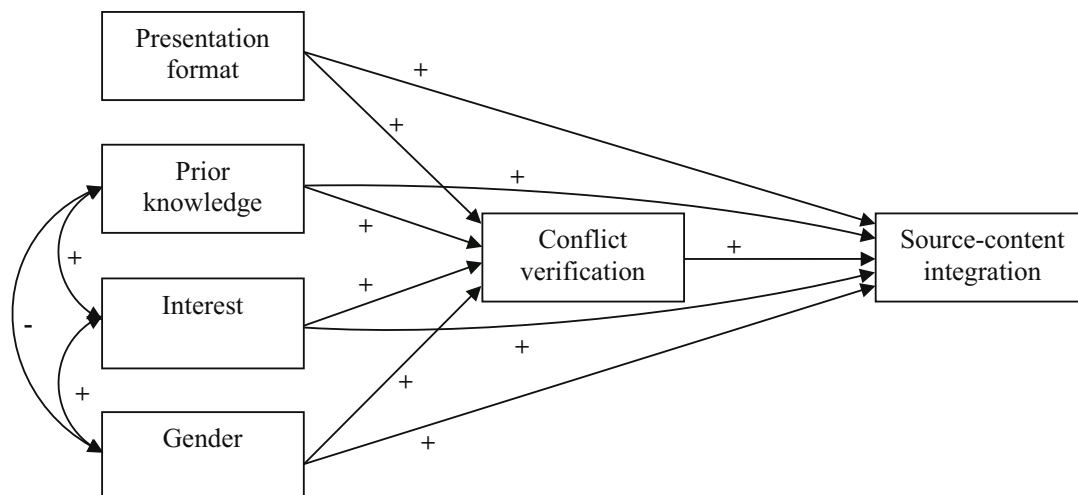
Taken together, the studies of Britt and Aglinskas (2002) and Stadtler et al. (2013) seem to indicate that when boundaries between documents are clearly demarcated, learners are more likely to pay attention to source information and construct source-content links, with the positive effect of distinct document boundaries on sourcing, at least in part, mediated by improved noticing of conflicts within the textual materials. However, as Stadtler (2017) recently pointed out, further research is needed to clarify how variation in document boundaries plays out in the context of multiple source use.

With respect to individual difference variables, there is solid evidence within the multiple source literature that learners' prior knowledge about the topic of the texts may contribute to their sourcing performance (Braasch, Bråten, Strømsø, & Anmarkrud, 2014; Bråten, Strømsø, & Salmerón, 2011; Rouet, Britt, Mason, & Perfetti, 1996; Rouet, Favart, Britt, & Perfetti, 1997; Strømsø, Bråten, & Britt, 2010; Wineburg, 1991). For example, Braasch et al. (2014) found that prior knowledge was a unique predictor of undergraduates' evaluation of the trustworthiness of sources when reading multiple conflicting texts on a scientific topic. Moreover, Trevors, Feyzi-Behnagh, Azevedo, and Bouchet (2016, Study 2), based on think-aloud and retrospective interview data, showed that prior knowledge also may facilitate noticing textual conflicts, with undergraduate readers reporting that their difficulties in noticing textual conflicts were due to limited prior knowledge. It is thus possible that prior knowledge may contribute indirectly (i.e., through noticing textual conflicts) as well as directly to learners' sourcing performance in multiple text contexts. Presumably, one reason that prior knowledge may facilitate noticing conflicts within textual information resources is that prior knowledge will promote co-activation of conflicting information in working memory during reading (Braasch & Bråten, 2017).

Compared to prior knowledge, less is currently known about the role of topic interest in students' noticing of textual conflicts and sourcing performance. It has been shown, however, that students' topic interest is positively correlated with their construction of source-content links when reading multiple source materials on a controversial socio-scientific issue (Strømsø et al., 2010). Because topic interest has been found to be positively related to deeper-level, elaborative processing of textual information (Krapp, 1999; Schiefele, 1999), it is also conceivable that topic interest may contribute to learners' detection of textual conflicts in multiple source contexts. Given an increased theoretical attention to the potential role of motivational factors in multiple source use (List & Alexander, 2017b), it seems highly pertinent to further research direct and indirect relationships between students' topic interest and their sourcing performance.

## The present study

Based on this theoretical and empirical background analysis, we developed the hypothesized model displayed in Fig. 1. The fit of this model was tested using data from upper-secondary students who read conflicting textual claims on the issue of sun exposure and health that were presented by different sources. The presentation format was varied so that some participants encountered the conflicting views and their respective sources in a condition where the boundaries between the information resources were made salient (i.e., a multiple text format), whereas others encountered the same conflicting views and their sources in a condition where the boundaries were more blurred (i.e., a single-text format). In addition to varying the presentation format in this way, we measured all participants' prior knowledge and interest and modeled the direct and indirect contributions of these individual difference variables to their sourcing performance.



**Fig. 1** The hypothesized model. Presentation format is coded 1 for multiple text format, 0 for single text format. Gender is coded 1 for females, 0 for males

In accordance with the D-ISC model and its supporting evidence (Braasch & Bråten, 2017; Bråten & Braasch, 2018), we hypothesized that the extent to which participants noticed textual conflicts would directly and positively affect their representation of source-content links. Moreover, in accordance with the documents-as-entities assumption (Britt et al., 2013) and empirical findings relevant to this assumption (Britt & Aglinskias, 2002; Stadtler et al., 2013), we hypothesized that presentation format would affect sourcing not only directly but also indirectly through its direct effect on the representation of textual conflicts. Specifically, we expected that compared to interacting with a single text, interacting with multiple texts would improve students' sourcing performance, directly as well as indirectly through its direct positive effect on the representation of textual conflicts. A direct effect of presentation format on sourcing could be expected because multiple texts may increase the salience of source information and the distinctiveness of document boundaries, thereby facilitating the representation of source-content links, even in the absence of textual conflicts (Britt et al., 2013; Salmerón, Gil, & Bråten, 2018), as well as lead to a deeper, more constructive processing of information compared to single texts (Wiley & Voss, 1999). For theoretical as well as empirical reasons that were discussed in the previous section (Braasch et al., 2014; List & Alexander, 2017b; Rouet & Britt, 2011; Schiefele, 1999; Strømsø et al., 2010; Trevors et al., 2016), we also hypothesized that the individual difference variables of prior knowledge and interest similarly would have both direct and indirect positive effects on students' sourcing performance. Given the clear differences previously found between Norwegian male and female secondary school students with respect to reading comprehension (in the favor of females) (Kjaernslie, Lie, Olsen, & Turmo, 2004), we also included gender in the model, hypothesizing that females would outperform males with respect to both noticing textual conflicts and tagging key content information for its source.

Finally, based on previous empirical findings, we included intercorrelations between the individual difference variables in the hypothesized model. Thus, several studies have demonstrated a positive relationship between prior topic

knowledge and topic interest (e.g., Bråten et al., 2014; Mason, Boscolo, & Tornatora, 2013; Taboada, Tonks, Wigfield, & Guthrie, 2009; Strømsø et al., 2010). Moreover, females have been shown to be more interested in health-related and socio-scientific risk issues than are males (Ek, 2015; Stenseth, Bråten, & Strømsø, 2016), whereas male students have been shown to outperform female students with respect to knowledge of natural science topics in most OECD countries, including Norway (Kjaernslie et al., 2004). Importantly, all the relationships included in the hypothesized model were expected to hold while controlling for the entire set of variables.

## Method

### Participants

Participants were 140 students (36.4% female, 63.6% male) from six classes at a public upper secondary school in southeast Norway. Their overall mean age was 16.21 years ( $SD = .48$ ). All participants were in their first year of upper secondary education and attended college preparatory courses. Most of the participants (81.4%) were native-born Norwegians whose first language was Norwegian, and the rest were bilingual. The sample was relatively homogeneous in terms of socioeconomic status (i.e., middle class). Participation was anonymous and voluntary, and the collection and handling of all data were based on the guidelines of the Norwegian Social Science Data Services.

### Materials

#### *Texts*

Participants read conflicting views on the issue of sun exposure and health. Sun exposure and health is a highly pertinent issue in regions of the world where sunlight is scarce in the winter and, therefore, very attractive in the summer. For example, in Norway, many young people reportedly use a sunbed and get burned in that context (Norwegian Cancer Association, 2009). The different views on sun exposure and health were taken from authentic source materials and represented real controversies that exist between sources with informative purposes about this unsettled socio-scientific issue (e.g., see Moan, Baturaite, Juzeniene, & Porojnicu, 2012).

In one presentation format, participants read about this issue in four separate texts. Two main conflicts were discussed in these text; one conflict concerned mental health and another conflict concerned physical health. The conflict concerning mental health was presented in one pair of texts and the conflict concerning physical health was presented in another pair of texts. Specifically, with respect to mental health, one text presented the view that lack of sun exposure may cause depression, whereas another text presented the view that, rather than depression, lack of sunlight is likely to cause sleeplessness. There were several

conflicting claims across the two texts concerning mental health. For example, one text said that many Norwegians are suffering from winter depression due to lack of sunlight, whereas the other text said that lack of sunlight does not lead to winter depression (and explained why). With respect to physical health, one text presented the view that sun exposure is harmful because it may lead to skin cancer, whereas another text presented the view that sun exposure is healthy because it increases the production of vitamin D and, therefore, can protect against all forms of cancer. There were also several conflicting claims across the two texts concerning physical health. For example, one of the texts said that one should always use factor 15 sunscreen during the summer, even when it is cloudy, whereas the other text said that some daily sun exposure without any sunscreen during the summer actually is healthy. The four texts ranged in length from 210 to 240 words ( $M = 224.75$ ,  $SD = 14.08$ ), with readability scores ranging from 38 to 43 ( $M = 41.50$ ,  $SD = 2.38$ ), which is comparable to the difficulty level of textbooks used in Norwegian upper secondary school. At the beginning of each text, source information was presented in the form of author's name, credentials, and affiliation, as well as publication venue and date of publication. Titles and source information for each of the four texts are presented in the "Appendix".

In another presentation format, participants read the same conflicting views on sun exposure and health as a 969-word single text (readability = 41). The content was identical in the two presentation formats with the exception that the single text contained two introductory sentences ("The relationship between sunlight and health is an important and current topic. This text presents an overview of this topic.") placed under a main heading ("Sunlight and health"). The content of the four separate texts followed after the two introductory sentences in the single-text format, located in four subsections of the text and with the titles of the four separate texts used as subheadings. Under each subheading, the same source information was given that appeared at the beginning of the corresponding separate text. For example, under the subheading "Vitamin D is important for the body," it said: "Under this heading, the content of a text by nutritionist Nina Sørensen at the Norwegian Food Safety Authority, which was published in the Journal of Food and Health in 2015, is presented." To provide an authentic source context for the single text, participants were informed in the upper left corner of the first page that the text was taken from forskning.no, which is an online research magazine published by a group of educational institutions..

### *Prior knowledge measure*

To assess participants' knowledge about the topic of sun exposure and health, we administered a 20-item multiple-choice measure that has been used and validated in prior research (e.g., Ferguson & Bråten, 2013; Stang Lund, Bråten, Brante, & Strømsø, 2017). The items referred to concepts and information relevant to the topic that were discussed in the text materials and covered issues related to both mental and physical health (e.g., depression, sleeplessness, skin cancer, and production of vitamin D). Participants' scores were the number of correct responses out of 20. The internal consistency reliability (Kuder–Richardson 20) for scores on the prior knowledge measure was .66.



### *Interest measure*

Participants' interest and involvement in health issues were assessed by means of an 8-item measure, where each item was rated on a 10-point scale (1 = *not at all true of me*, 10 = *very true of me*). Four of the items asked participants to rate their interest without targeting any active involvement in health issues (sample item: I am interested in issues that concern our health), whereas four other items were more focused on their active involvement in health issues by targeting intentions to live a healthy lifestyle (sample item: I try to convince others that we must live healthier). This measure has also been used and validated in prior research (Stang Lund et al., 2017). By dividing participants' sum scores by the number of items, their scores on this measure ranged from 1 to 10. The internal consistency reliability (Cronbach's  $\alpha$ ) for the interest scores was .92.

### *Memory for textual conflicts*

To assess participants' memory for textual conflicts, we used a conflict verification task that was patterned after the conflict verification task developed and used by Stadtler and colleagues (Stadtler et al., 2013; Stadtler, Scharrer, Skodzik, & Bromme, 2014). The same task was recently used and validated by Stang Lund et al. (2017). This task contained 20 statements that were followed by two questions each. Each question had to be answered "yes" or "no". The first question following each statement was "Is this claim consistent with what you read in one of the texts?" (multiple text format) or "Is this claim consistent with what you read in the text?" (single text format). The second question following each statement was "Did you read anything in one of the other texts that is in conflict with this claim?" (multiple text format) or "Did you read anything else in the text that is in conflict with this claim?" (single text format). Eight of the 20 statements on the conflict verification task were paraphrases of textual claims that conflicted with a claim presented in another text (multiple text format) or in another subsection of the same text (single text format). Following Stadtler et al. (2013), such items were termed "attractor items". Eight other items were paraphrases of textual claims that did not conflict with a claim presented in another text (multiple text format) or in another subsection of the same text (single text format). Following Stadtler et al. (2013), such items were termed "uncritical items". The four remaining items were claims about health issues that were neither presented in any of the texts/anywhere in the text, nor were they in conflict with any other claim presented therein. These items were termed "distractor items" (Stadtler et al., 2013). In accordance with the scoring procedure established in prior research (Keck, Kammerer, Staraschek, 2015; Stadtler et al., 2013, 2014; Stang Lund et al., 2017), we corrected for a tendency to answer in the positive when scoring this task. This means that each participant received a score based on the difference between the proportion of the attractor items for which both questions were answered in the affirmative and the proportion of the uncritical items for which both questions were answered in the affirmative (i.e., false positives). This resulted in scores on the conflict verification task that theoretically ranged from -1 (none of the attractor items were correctly identified as conflicting claims and all of

the uncritical items were misidentified as conflicting claims) to 1 (all of the attractor items were correctly identified as conflicting claims and none of the uncritical items were misidentified as conflicting claims). A score of 0 would mean that a participant correctly identified the same proportion of attractor items as conflicting claims (e.g., 4 out of 8, yielding a proportion score of .50) as he or she misidentified uncritical items as conflicting claims (e.g., 4 out of 8, yielding a proportion score of .50). Participants' scores on the conflict verification task had an internal consistency reliability (Cronbach's  $\alpha$ ) of .73. This reliability estimate was calculated based on participants' responses to both questions for the attractor items as well as for the uncritical items (Keck et al., 2015; Stadler et al., 2013, 2014).

### *Source-content integration task*

To assess participants' source-content integration, we administered a task asking them to connect textual contents with the respective sources. This task has been used and validated as a measure of sourcing performance in several previous studies (Kammerer, Meier, & Stahl, 2016; Stang Lund et al., 2017; Strømsø et al., 2010). In this task, participants were presented with four text sentences, one from each of the four texts (multiple text format) or from each of the four subsections of the text (single text format), together with four distractor sentences. Each of the four text sentences presented key information from the corresponding text or subsection, whereas the content of the four distractor sentences was not covered in any of the texts or subsections. Still, the content of the distractors were related to the topic of sun exposure and health. Each of the eight sentences of the source-content integration task was accompanied by five letters (A–E). Each of the first four letters (A–D) represented one of the sources and the last letter (E) represented the alternative that the content of the sentence did not come from any of the sources. Please remember that information about the sources of the textual contents was identical in the two presentation formats. The five optional letters were explained in the instruction by linking each of them to source information about a particular text or subsection or to information not found in any of the texts or subsections (e.g., B: Nutritionist Nina Sørensen, Norwegian Food Safety Authority, Journal of Food and Health, 2015; E: Information not located in anything you read). Participants were instructed to mark each key sentence with the correct letter (A–D) to indicate the source of the information, or, alternatively, to mark a sentence E if the information did not come from any of the sources. One point was awarded for each of the eight items that participants marked correctly. The scores on the source-content integration task yielded an internal consistency reliability (Cronbach's  $\alpha$ ) of .65.

### **Procedure**

The five authors and one trained research assistant group administered the materials during a 45-min class period. Each participant was given a folder that contained all the materials in the following order: (a) a demographics survey, (b) the prior knowledge measure, (c) the interest measure, (d) the text/s, (e) the source-content

integration task, and (f) the conflict verification task. Participants were orally informed to work with the materials in the same order.

Of note is that the text/s were placed in a folder within the folder that was marked “Text folder”. In the multiple text format, the four texts were presented on four separate sheets of paper, whereas in the single text format, the text was presented on two sheets that were stapled together. Participants read the following instruction before starting on the text/s, with this instruction also provided on a separate sheet: “The relationship between sunlight and health is an important topic. Several research what kind of influence sunlight, or the lack of sunlight, may have on our health. While some are mainly concerned about physical health, others are concerned about mental health. You are now going to read four different texts/a text about this topic. After you have read the text/s, we will give you some questions to examine what you have learned about this topic. When you answer those questions, you will not be permitted to look at the text/s.”

Participants in each of the six classes were randomly assigned to two versions of the multiple text format and the single text format. The only difference between the two versions of the multiple text format was that in one of the versions, the first sentence of each text contained a cross-reference to the text in the set that presented a conflicting view (cf., Stadtler et al., 2014). However, because preliminary analyses showed that the two versions of the multiple text format did not lead to any differences with respect to memory for textual conflicts or source-content integration, participants receiving the two versions of the multiple text format were collapsed into a single group for all further statistical analyses.<sup>1</sup>

In the multiple text format, the conflicting issue of sun exposure and mental health and the conflicting issue of sun exposure and physical health were presented in counterbalanced order in the text folders, as were the two texts dealing with each issue. In the single text format, the same counterbalanced order of the two conflicting issues and of the subsections dealing with each issue was used.

The test administrators ensured that all participants put the text/s back into the text folder after reading. To minimize measurement reactivity (French & Sutton, 2010), we eventually had all participants complete the source-content integration task before the conflict verification task.

## Results

Table 1 shows zero-order correlations among the measured variables for the entire sample, with gender also included in the correlation matrix. Descriptive statistics for the measured variables by text format are shown in Table 2. Participants who read multiple texts about sun exposure and health scored statistically significantly higher

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<sup>1</sup> On the conflict detection task, participants who got the version with cross-references scored 0.38 and those who got the version without cross-references scored 0.36, with  $t(83) = .18$ ,  $p = .86$ . On the source-content integration task, participants who got the version with cross-references scored 4.93 and those who got the version without cross-references scored 5.49, with  $t(81) = -1.37$ ,  $p = .18$ . There were also no differences between the two versions of the multiple text format with respect to prior knowledge or interest,  $t_s < 1$ .

**Table 1** Zero-order correlations for all participants ( $n = 140$ )

Variable	1	2	3	4	5
1. Conflict verification	–				
2. Source-content integration	.45**	–			
3. Prior knowledge	.24**	.31**	–		
4. Interest	.11	– .07	.07	–	
5. Gender	.02	.09	– .19*	.26**	–

Female = 1, male = 1. \* $p < .05$ ; \*\* $p < .01$

**Table 2** Descriptive statistics for all measured variables by text format

Variable	Multiple-text format ( $n = 86$ )			Single-text format ( $n = 54$ )		
	<i>M</i>	<i>SD</i>	Skewness	<i>M</i>	<i>SD</i>	Skewness
Conflict verification	.37	.35	– .73	.25	.27	.01
Source-content integration	5.22	1.89	– .34	4.04	1.97	– .17
Prior knowledge	15.89	2.72	– .49	14.79	3.29	– .50
Interest	6.00	2.03	.08	6.69	1.78	– .17

on the conflict verification task ( $M = .37$ ,  $SD = .35$ ) than did those who read a single text ( $M = .25$ ,  $SD = .27$ ),  $t(137) = 2.08$ ,  $p = .040$ , Cohen's  $d = .38$ .<sup>2</sup> Likewise, those who read multiple texts scored statistically significantly higher on the source-content integration task ( $M = 5.22$ ,  $SD = 1.89$ ) than did those who read a single text ( $M = 4.04$ ,  $SD = 1.97$ ),  $t(132) = 3.45$ ,  $p = .001$ , Cohen's  $d = .61$ . Inadvertently, however, there were also statistically significant differences between the two text formats with respect to prior knowledge (multiple texts:  $M = 15.89$ ,  $SD = 2.72$ ; single text:  $M = 14.79$ ,  $SD = 3.29$ ) and interest (multiple texts:  $M = 6.00$ ,  $SD = 2.03$ ; single text:  $M = 6.69$ ,  $SD = 1.78$ ), with  $t(128) = 2.06$ ,  $p = .041$ , Cohen's  $d = .33$ , for prior knowledge, and  $t(137) = -2.05$ ,  $p = .042$ , Cohen's  $d = .36$ , for interest. Thus, whereas those who read multiple texts scored

<sup>2</sup> On average, the participants in the multiple-text condition correctly identified 3.95 of the attractor items as conflicting claims, yielding a proportion score of 0.49 (i.e., 3.95/8) for these items. On average, they misidentified 1.00 of the uncritical items as conflicting claims, yielding a proportion score of 0.12 (i.e., 1.00/8) for the uncritical items. Their score on the conflict verification task was computed by subtracting the proportion score for the misidentified conflicts (0.12) from the proportion score for the correctly identified conflicts (0.49), yielding a final score of 0.37. On average, the participants in the single-text condition correctly identified 2.85 of the attractor items as conflicting claims, yielding a proportion score of 0.36 (i.e., 2.85/8) for these items. On average, they misidentified 0.86 of the uncritical items as conflicting claims, yielding a proportion score of 0.11 (i.e., 0.86/8) for these items. Their final score was the proportion of misidentified conflicts (0.11) subtracted from the proportion of correctly identified conflicts (0.36), equaling 0.25. Of the 140 participants, 14 had negative scores on the conflict verification task. This might indicate that some participants had misunderstood or not read the task instruction, statements, or questions carefully, or that they simply had not put time or effort into responding to this task.

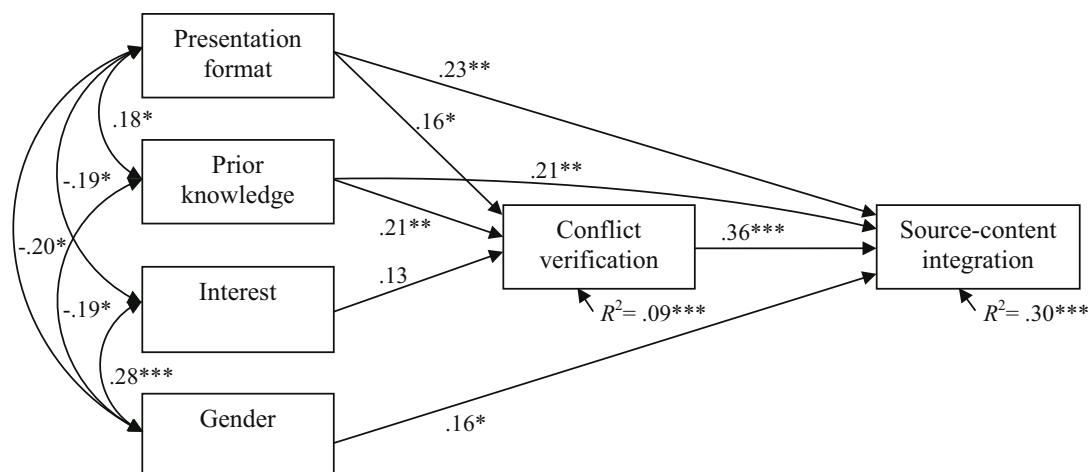
higher with respect to prior knowledge, the opposite was true for interest. Finally, it turned out that female and male students were distributed differently across the two text formats, with 49% of the girls and 68.5% of the boys reading multiple texts,  $\chi^2(1) = 25.36$ ,  $p = .022$ , Cramer's  $V = .19$ .

Please note that the scores on the conflict verification task indicated that after correction for students' tendency to answer in the positive, participants identified only 25 and 37% of the textual conflicts, respectively. Still, the average score obtained for the single-text format was higher than the score reported in Stadler et al. (2013) for undergraduates reading a single text, and the average score obtained in the multiple-text format was higher than the scores reported in Stadler et al. (2014) for undergraduates reading multiple texts. Moreover, the scores on the source-content integration task indicated that the participants in the two conditions correctly marked 51 and 65% of the presented sentences, which seems comparable with previous results obtained for source-content integration when secondary school students read single or multiple texts (Kammerer et al., 2016b; Stang Lund et al., 2017; Strømsø et al., 2010).

We tested the fit of the hypothesized model to the data by means of the Mplus 7.11 software (Muthén & Muthén, 2013), using maximum likelihood path analysis and several fit indices reported by the software and recommended in the literature (Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004). These fit indices did not indicate that the hypothesized model shown in Fig. 1 fit the data well, however, with  $\chi^2(3, n = 140) = 10.22$ ,  $p = .017$ , comparative fit index (CFI) = .87, root mean square error of approximation (RMSEA) = .130, standardized root mean residual (SRMR) = .062. We therefore respecified and reevaluated the model with two statistically nonsignificant paths and one nonsignificant correlation deleted. These included the path from interest to sourcing performance and the path from gender to memory for textual conflicts, as well as the correlation between prior knowledge and interest. In addition, we took the accidental differences between the text format groups with respect to prior knowledge, interest, and gender into consideration and included intercorrelations between presentation format and these individual difference variables in the model. Presumably, the main reasons that the hypothesized model did not fit the data well were that interest did not predict source-content integration, that gender did not predict memory for textual conflicts, and that intercorrelations between presentation format and the individual difference variables (i.e., prior knowledge, interest, and gender) had not been taken into consideration in developing the hypothesized model.

The resulting model is displayed in Fig. 2. Taken together, the fit indices indicated that this model fit the data well, with  $\chi^2(3, n = 140) = 4.87$ ,  $p = .182$ , CFI = .97, RMSEA = .067, SRMS = .029.

Figure 2 shows that there was a direct effect of memory for textual conflicts on source-content integration, with  $\beta = .36$ ,  $p < .001$ . Moreover, there were direct effects of the textual factor of presentation format ( $\beta = .23$ ,  $p = .002$ ) and the individual factors of prior knowledge ( $\beta = .21$ ,  $p = .002$ ) and gender ( $\beta = .16$ ,  $p = .028$ ) on source-content integration. Thus, the better students remembered that they had read conflicting claims on the issue of sun exposure and health, the more likely they were to construct mental representations that included links between



**Fig. 2** The final model including standardized path coefficients and explained variance in the prediction of the dependent variables. Presentation format is coded 1 for multiple text format, 0 for single text format. Gender is coded 1 for females, 0 for males. \* $p < .05$ ; \*\* $p < .01$ , \*\*\* $p < .001$

sources and textual content. In addition, students who read multiple texts were more likely to form source-content links than were those who read a single text, and students with higher prior knowledge and girls were more likely to form such links than were students with lower prior knowledge and boys.

The textual factor of presentation format ( $\beta = .16$ ,  $p = .046$ ) and the individual factor of prior knowledge ( $\beta = .21$ ,  $p = .010$ ) also had direct effects on memory for textual conflicts. The direct effect of topic interest on memory for textual conflicts did not reach statistical significance, however ( $\beta = .13$ ,  $p = .110$ ). The predictors explained 9% of the variance in memory for textual conflicts ( $p < .001$ ).

Finally, both the textual factor of presentation format ( $\beta = .059$ ,  $p = .049$ ) and the individual factor of prior knowledge ( $\beta = .074$ ,  $p = .015$ ) had indirect effects on source-content integration that were mediated by memory for textual conflicts. Altogether, the model explained 30% of the variance in source-content integration ( $p < .001$ ), which can be considered a large effect (Cohen, 1988; Ellis, 2010).

## Discussion

Paying attention to the source of textual information may be essential to critically evaluate and assign proper weight and importance to that information when trying to understand a situation, topic, or issue (Britt et al., 2013; Goldman, 2004; Rouet, 2006; Wineburg, 1991). In particular, this concerns reading contexts in which individuals seek information about controversial issues conveyed by multiple sources, where conflicting claims are the rule rather than the exception (Bromme & Goldman, 2014; Sinatra, Kienhues, & Hofer, 2014). Understanding the textual and individual difference factors that underlie readers' construction of source-content links is therefore an important research agenda for 21st century learning and literacy (Bråten et al., 2018; Britt & Rouet, 2012). In our view, the current contribution is

unique in this regard, providing new insight into how textual and individual factors, when examined simultaneously, may not only directly but also indirectly contribute to “sourcing in the reading process” (Scharrer & Salmerón, 2016).

Thus, our assumption regarding the direct and indirect effects of the textual factor of presentation format was confirmed. Consistent with prior research in history (Britt & Aglinskias, 2002), interacting with information resources with clear boundaries, such as in the multiple-text presentation format, improved sourcing performance compared to interacting with information resources with less clear boundaries, such as in the single-text presentation format. Moreover, presentation format had an additional, indirect effect on sourcing performance mediated through memory for textual conflicts. In corroboration of findings reported by Stadtler et al. (2013), encountering different perspectives on the issue in multiple distinct texts facilitated the representation of textual conflicts in readers’ memory, compared to encountering the same perspectives in a single-text format. The finding that readers’ memory for textual conflicts, in turn, contributed to their sourcing performance and thus mediated the effects of presentation format on readers’ sourcing is unique to the current study, however.

Theoretically, the direct and indirect effects of presentation format that we observed highlight the importance of considering the D-ISC model (Braasch & Bråten, 2017), which foregrounds the role of conflict in sourcing, in juxtaposition with the documents-as-entities assumption (Britt et al., 2013), which foregrounds the role of document boundaries. Thus, in accordance with the D-ISC model, the representation of textual conflicts may seem to affect the construction of links between sources and content. The extent to which readers notice textual conflicts when interacting with multiple conflicting sources, however, may, in part, depend on whether the boundaries between the information resources are clearly demarcated. This qualification of the D-ISC model is in accordance with the documents-as-entities assumption, as is the direct effect of presentation format on source-content integration that we observed in the current study.

Our assumption regarding the direct and indirect effects of the individual difference variable of prior knowledge was also confirmed. The finding that prior knowledge may uniquely predict readers’ sourcing performance is consistent with prior research (e.g., Braasch et al., 2014; Bråten et al., 2011). Also, the finding that prior knowledge is associated with the representation of textual conflicts corroborates previous findings (Trevors et al., 2016). The finding that prior knowledge indirectly may contribute to readers’ sourcing through the representation of textual conflicts is unique to this study, however. In terms of theory, this finding suggests further refinement of models trying to capture the influence of prior knowledge in multiple-source contexts (Britt & Rouet, 2012; Rouet & Britt, 2011; Rouet et al., 2017). Presumably, higher prior knowledge may facilitate the co-activation of conflicting textual information in working memory, making it more likely that readers experience and mentally represent the conflicts (van den Broek & Kendeou, 2015). In trying to overcome such conflicts and achieve coherence in their mental representations, readers may then strategically take information about the sources into consideration (Braasch & Bråten, 2017).

The assumption that interest both directly and indirectly might contribute to readers' sourcing performance was not supported, however. One possible reason is that the interest measure that we used concerned interest in health issues in general rather than interest in the more specific topic of sun exposure and health, with further specification of the items potentially improving the predictability of scores on this measure. Another possibility is that the time, effort, and persistence (i.e., behavioral engagement) that students actually put into complex reading tasks are more relevant predictors of performance than is topic interest self-reported on a scale (Bråten, Brante, & Strømsø, in press). In any case, given current accentuations of the role of motivational factors in multiple source use (Bråten et al., 2014; List & Alexander, 2017b; List & Alexander, 2018), further research on the status of topic interest in a network of textual and individual difference variables is highly pertinent.

With respect to gender, this variable was found to directly, but not indirectly, predict sourcing performance. Thus, when controlling for all other variables, gender influenced the extent to which readers linked key textual information to its respective source. While this finding is consistent with previous findings showing that female secondary school students generally are better comprehenders than are males (Kjaernsli et al., 2004), it also highlights a specific area of female distinction within 21st century literacy. Of note is, however, that the role of gender in multiple source use has hardly been examined in a systematic fashion thus far. In doing so, future researchers should also investigate whether and how the role of gender might vary with the particular issue discussed by different sources.

Of course, the current study has several limitations that suggest avenues for future research. As indicated above, it is relevant to test the generalizability of our findings when students read conflicting views about other issues. Moreover, the generalizability of our findings should be tested with other student populations, in other reading contexts, and with other types of outcome measures (see below). Thus, while our study seems to fare better than much other reading research in terms of ecological validity, focusing on the reading of multiple authentic texts representing real controversies on an important, unsettled socio-scientific issue, the reading context and tasks were designed for experimental purposes. Whether our main findings will hold up when more naturalistic reading is considered is a question for future research.

Although our path analytic approach indicated that presentation format was a causal factor because this factor was manipulated experimentally, it should also be noted that we cannot be sure about the direction of the effects or rule out the possibility of bidirectional relationships between other constructs, in particular between the constructs of conflict verification and source-content integration. That said, it is consistent with the D-ISC model (Braasch & Bråten, 2017) as well as empirical work framed by this model (for reviews, see Braasch & Bråten, 2017; Bråten & Braasch, 2018) that the identification of textual conflicts, as measured by the conflict verification task, is a causal predictor of the construction of source-content links. Of note is, however, that such links, in turn, may help learners understand and resolve the textual conflicts in building a coherent representation of the issue (Bråten et al., 2014; Perfetti et al., 1999; Stadtler & Bromme, 2014). In any case, further longitudinal or, preferably, experimental studies targeting those



constructs are needed. In such research, including processing data on students' noticing of textual conflicts during reading is preferable. Thus, while the conflict verification task that we used might allow some inferences about students' attention to textual conflicts during reading, online measures, for example concurrent verbal protocols (Ericsson & Simon, 1980), can be used in future studies to more directly investigate processing differences resulting from differences in presentation format. Such an approach would also address a potential limitation of the conflict verification task that is related to the fact that participants in the multiple-text condition were asked whether they read conflicting information in one of the other texts, whereas participants in the single-text condition were asked whether they read conflicting information in the (same) text. As suggested by one of the anonymous reviewers, it cannot be entirely ruled out that participants considered textual conflicts more likely between texts than within a text, such that the formulation of the questions on the conflict verification task in the two conditions might have influenced the results. Although this seems less likely given that participants in the multiple-text condition also would have been prompted by the formulation "in one of the other texts" to produce more false positives, decreasing their scores on the conflict verification task, future research in this area should replace or supplement the conflict verification task with online processing data to validate the results obtained with this task in the current study. Because the reliability of participants' scores on the source-content integration measure was somewhat lower than desirable, it is also important to ensure that source-content integration is reliably measured in future research.

Finally, it may be regarded as a limitation that we did not include a measure dedicated to participants' comprehension of the controversial issue. Of note is, however, that this study focused on testing specific hypotheses derived from theory and prior research about the impact of textual and individual difference factors on students' conflict verification and source-content integration. Moreover, both these outcome measures (i.e., conflict verification and source-content integration) can be said to capture essential aspects of multiple source comprehension (Braasch & Bråten, 2017; Britt et al., 2013), with source-content integration, for example, found to predict integrated understanding of multiple conflicting texts in prior research (Strømsø et al., 2010). Still, an additional measure targeting readers' integrated understanding of the issue at hand could be included in future research. Following prior work using multiple texts on the controversial issue of sun exposure and health (e.g., Bråten et al., 2014; Ferguson & Bråten, 2013), such a measure could assess students' ability to corroborate information from different sources and reason about the issue in terms of claims and evidence concerning different perspectives. For example, using short-essay questions, prior research (Bråten et al., 2014; Ferguson & Bråten, 2013) has regarded students' ability to describe and elaborate different perspectives on the issue, as well as relate them to each other by explaining how they may be reconciled, as evidence of good (i.e., integrated) multiple text comprehension.

Despite the limitations, our study has some intriguing educational implications in addition to its theoretical significance. For example, it highlights the importance of using information resources with clearly demarcated boundaries or directing students' attention to boundaries between information resources when they deal with conflicting source materials. This may challenge the use of traditional textbooks or other educational materials that tend to blur or obscure boundaries between documents, for example because digests of different documents are wrapped or compiled within a single source. In support of this view, Nokes, Dole, and Hacker (2007), in an intervention study, showed that secondary school students who worked with multiple, authentic historical documents improved their sourcing skills compared to those who worked with traditional textbooks. Moreover, this study informs teachers about individual differences that should be taken into account when trying to design adaptive teaching of multiple source use in their classrooms. Finally, it suggests that providing students with strategies that help them notice textual conflicts is a worthwhile instructional approach to multiple source use. In this regard, much research on comprehension monitoring training (Afflerbach, 2002; Baker & Beall, 2009) is informative, with such training having the potential to promote student awareness of conflicting views on the same issue and concomitant breaks in situational coherence. In turn, this awareness may create a need to strategically think about the sources of conflicting information, which can be considered an essential multiple source literacy skill.

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## Appendix

Title and source information for each of the four texts

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Lack of light causes depression

Psychologist Anita Lund

Association for Mental Health

helsenorge.no<sup>a</sup>

2016

Too little daylight leads to sleeplessness

Lecturer Kristin Iversen

Norwegian School of Sports Sciences

Olympiatoppen.no<sup>b</sup>

2013

Sunbathing causes cancer

Chief physician Hilde Dahl

The Norwegian Cancer Association

Journal of Medicine

2014

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Vitamin D is important for the body

Nutritionist Nina Sørensen

Norwegian Food Safety Authority

Journal of Food and Health

2015

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<sup>a</sup>A Norwegian public health information website

<sup>b</sup>The website of the Norwegian Olympic and Paralympic Committee and Confederation of Sports

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# To click or not to click: investigating conflict detection and sourcing in a multiple document hypertext environment

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## Abstract

This study investigated whether accessing conflicting claims in other documents by means of hyperlinks embedded within currently read documents may facilitate conflict detection and source-content integration. Norwegian undergraduates ( $n=85$ ) read multiple conflicting documents on a controversial health-related issue, with half of the conflicting claims across documents hyperlinked and the other half not. Moreover, half of the participants were told that they would get more information by clicking on the links (weak prompting condition) while the other half were additionally told that clicking on the links was necessary to get a more complete understanding of the issue (strong prompting condition). Results indicated that the extent to which participants accessed conflicting claims in other documents via the hyperlinks was positively related to their detection of cross-document conflicts as well as their integration of source-content information. A mediational analysis indicated that conflict detection mediated the effect of accessing conflicting claims via the hyperlinks on source-content integration. No relationship was found between the prompting condition and participants' selection of the hyperlinks. The theoretical significance as well as the practical value of our findings are discussed.

**Keywords** Multiple document literacy · Conflicting information · Sourcing · Hypertext · Hyperlinks

When people use multiple information resources to learn about a particular situation, issue, or phenomenon, attention to the sources of information is often crucial (Bråten, Stadtler, & Salmerón, 2018; Magliano, McCrudden, Rouet, & Sabatini, 2018). Especially when people read about complex, controversial, and

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unfamiliar issues, such as the potential health effects of sun exposure (Moan, Baturaitė, Juzeniene, & Porojnicu, 2012), they may have a hard time determining the accuracy and trustworthiness of differing knowledge claims directly (Stadtler & Bromme, 2014). In such situations, it may therefore be highly pertinent to take features of the sources into consideration, for example, the author's affiliation and credentials, the document type (e.g., a scholarly article or an op-ed), the venue, and the date of publication (e.g., Bråten, McCrudden, Stang Lund, Brante, & Strømsø, 2018; McCrudden, Stenseth, Bråten, & Strømsø, 2016; Stadtler & Bromme, 2014). Such consideration of source information, termed "sourcing" within the area of multiple document literacy research (Bråten, Stadtler, & Salmerón, 2018; Scharrer & Salmerón, 2016; Wineburg, 1991), allows readers to evaluate the potential accuracy and trustworthiness of knowledge claims indirectly, that is, in light of the features of the sources (Rouet, 2006; Stadtler & Bromme, 2014). Presumably, prioritizing information from competent, unbiased, vetted, and updated sources will help learners build a more appropriate, higher-quality mental representation of the issue in question and counteract tendencies to waste time and effort on information of dubious quality (Bråten, Strømsø, & Britt, 2009; Britt, Rouet, & Braasch, 2013).

Thus, on the one hand, readers may evaluate source information before deciding whether to incorporate the content from a particular document into their mental representation when learning about a controversial issue. For example, intervention studies examining secondary school students' post-reading essays found that they more often included content from more authoritative, reliable sources after training (Braasch, Bråten, Strømsø, Anmarkrud, & Ferguson, 2013; Mason, Junyent, & Tornatora, 2014). Notably, a recent eye-tracking study reported that undergraduates who were encouraged to pay attention to source information in an Internet-based multiple-document scenario invested more time than a control group in scrutinizing the search engine results page (SERP) before accessing the web pages. Accordingly, the inclusion of information from the more trustworthy pages in participants' post-reading essays was mediated by the time devoted to reading the SERP (Authors, under review).

On the other hand, it could be the case that source evaluation takes place once learners have already linked source information and semantic content, that is, noted and remembered "who says what" as a basis for source-content integration (Britt, Perfetti, Sandak, & Rouet, 1999; Perfetti, Rouet, & Britt, 1999; Rouet, 2006). It is therefore of great concern to literacy researchers that students at different educational levels have been found to typically disregard source information and pay attention only to the content in multiple document reading contexts (e.g., Barzilai, Tzadok, & Eshet-Alkalai, 2015; Bråten, Strømsø, & Andreassen, 2016; Kiili, Leu, Martuunen, Hautala, & Leppänen, 2018). At the same time, however, a range of individual difference and contextual factors have been shown to influence the extent to which learners take source information into consideration when reading multiple documents (for review, see Bråten, Stadtler, & Salmerón, 2018). In the current research, we address one specific contextual factor that has attracted much attention from researchers during the last decade: whether different sources provide conflicting accounts of the same situation or issue. In doing so, we build on the discrepancy-induced source comprehension (D-ISC) model of Braasch et al. (Braasch & Bråten, 2017; Braasch, Rouet, Vibert, & Britt, 2012) and prior research supporting

this model (for reviews, see Braasch & Bråten, 2017; Bråten & Braasch, 2018). However, moving beyond prior research framed by the D-ISC model, this is the first study that tests core assumptions of the D-ISC model within a hypertext environment allowing learners to access conflicting information from different sources via hyperlinks, which may facilitate the detection of conflicting claims across multiple documents and thereby promote the construction of source-content links (Braasch & Bråten, 2017; Braasch et al., 2012).

Before we further describe the unique aspects of our study, as well as the hypotheses that guided the current research, we briefly discuss the D-ISC model and prior research framed by this model. Because we created a hypertext environment to test assumptions of the D-ISC model in this study, we also provide a brief discussion of the opportunities and challenges of hypertext as a background.

## Theoretical and empirical background

According to the D-ISC model, attention to sources, in particular to “who says what” (i.e., source-content links), will increase when learners detect conflicts across different documents (Braasch & Bråten, 2017; Braasch et al., 2012). When different documents contain conflicting information about the same issue, information from a prior document is likely to return to working memory when learners encounter overlapping, yet conflicting information in a currently read document. In turn, such co-activation of conflicting information from different documents in working memory produces experiences of cognitive conflict, which learners try to resolve by shifting their attention toward sources. The basic idea is that noting and remembering the sources of the different views may help learners understand the conflict and build a coherent mental representation of the issue by using information about the respective sources as organizational elements (Braasch & Bråten, 2017; Bråten & Braasch, 2018).

A number of recent empirical investigations have confirmed that sourcing may increase when learners encounter conflicting claims (Barzilai & Eshet-Alkalai, 2015; Braasch et al., 2012; Kammerer, Kalbfell, & Gerjets, 2016; Rouet, Le Bigot, de Pereyra, & Britt, 2016; Salmerón, Macedo-Rouet, & Rouet, 2016; Saux et al., 2017, 2018; Stadtler, Scharrer, Skodzik, & Bromme, 2014; Stang Lund, Bråten, Brandmo, Brante, & Strømsø, 2019; Stang Lund, Bråten, Brante, & Strømsø, 2017). In particular, the studies by Stang Lund et al. (2017, 2019) are relevant in the current context because these authors investigated the predictability and mediating role of conflict detection for source-content integration when students read multiple conflicting documents on a controversial socio-scientific issue. Thus, in their first study, Stang Lund et al. (2017) showed that conflict detection was a unique positive predictor of source-content integration after controlling for prior knowledge, interest, and critical reading strategies. In a follow-up, path analytic study, Stang Lund et al. (2019) showed that conflict detection mediated the effect of presentation format (i.e., reading conflicting information in multiple documents vs. a single document) on source-content integration when other cognitive and motivational factors were controlled for.

Prior research framed by the D-ISC model has varied with respect to the reading materials, with conflicting claims presented by different sources embedded within a single document (e.g., Braasch et al., 2012; Rouet et al., 2016) or by the sources of different documents (e.g., Barzilai & Eshet-Alkalai, 2015; Kammerer et al., 2016a). Moreover, documents presenting conflicting information have varied in length from very brief researcher-generated texts (e.g., Braasch et al., 2012; Rouet et al., 2016) to longer, more authentic texts (e.g., Barzilai & Eshet-Alkalai, 2015; Stang Lund et al., 2017) and from traditional printed texts (Stang Lund et al., 2017, 2019) to digital documents (e.g., Kammerer & Gerjets, 2014; Kammerer et al., 2016a, 2016b). However, no prior study in this area has presented multiple conflicting documents in a hypertext environment where learners can access conflicting claims in another document by clicking on links embedded within the document currently read. By doing this, we wanted to examine whether this unique affordance of a hypertext environment may facilitate conflict detection and sourcing because it increases the likelihood that conflicting claims are activated or attended to simultaneously, as required by the D-ISC model.

Hypertext can be defined as a digital document in which information is connected to related information in other documents by means of embedded links, creating a navigable network of information that readers can access and re-access at their own discretion (Landow, 2006). Theorists and researchers have applauded the potential of hypertext to facilitate readers' adaptive construction of knowledge. In particular, within the influential cognitive flexibility theory of Spiro and colleagues (e.g., Jacobson & Spiro, 1995; Spiro, Coulson, Feltovich, & Anderson, 1994), hypertext allows for a "criss-crossing" of a conceptual landscape from multiple intellectual points of view that helps readers build a rich and flexible representation of a complex issue. According to Spiro, Klautke, and Johnson (2015), such representations may have "rearrangeability" as an essential characteristic, meaning that they have "a built-in potential to achieve different forms for different purposes at different times in later contexts of application" (p. 48).

At the same time, however, there are several challenges involved in the reading of hypertext. In particular, when trying to assemble coherent understanding of an issue from a linked network of information, readers easily may be distracted and confused and lose track of the issue they set out to investigate (Bråten, Braasch, & Salmerón, in press; Cho & Afflerbach, 2017; Salmerón, Strømsø, Kammerer, Stadtler, & van den Broek, 2018; van den Broek & Kendeou, 2015). Thus, navigating across linked information in multiple documents in a way that builds rather than disturbs coherent understanding is crucial to benefit from the affordances of hypertext reading (Nauermann, 2015; Salmerón, Kammerer, & Delgado, 2018). According to the Information Foraging Theory (Pirolli, 2007), navigation via hyperlinks is determined by the perceived likelihood that linked content matches individuals' search goals, with individuals tending to select hyperlinks that activate semantic content strongly associated with the desired content in semantic memory. While this essentially describes a dumb, spreading activation mechanism underlying the selection of hyperlinks, others have highlighted the effortful, strategic activity underlying the construction of coherent reading paths in hypertext environments (Cho & Afflerbach, 2017). Thus, Cho and Afflerbach (2017) described how readers may use strategies to manage

information spaces and navigate toward useful texts (e.g., scrutinize hyperlinks to anticipate and judge the usefulness and significance of the information before accessing it, based on specific reading goals), to build intertextual linkages and make meanings from hypertexts (e.g., use the meaning constructed in the course of navigating and reading multiple texts to build an integrative mental model), to monitor the construction of reading paths (e.g., determine that located information is not useful and note disorientation), and to evaluate links and textual information (e.g., evaluate the result of a search or move in hypertext).

In any case, a fundamental challenge with the reading of hypertext exists because the building of integrated understanding requires that readers consider how pieces of information encountered in spatially distinct texts relate to each other (Salmerón, Strømsø, et al., 2018; van den Broek & Kendeou, 2015). This is demanding not only because readers must hold information from spatially distinct texts in working memory simultaneously, but also because the construction of incoherent navigation paths may lead readers astray and disturb the integration process (Salmerón, Cañas, Kintsch, & Fajardo, 2005). That said, because hyperlinks more often than not connect texts that are conceptually related, they may also support the integration of information across texts. In a conventional linear text, the integration of different parts of the text in the reader's mental model (Kintsch, 1998) is usually facilitated by semantic connections and verbal organizers that foster co-activation of different pieces of information (Rouet, 2006). Similarly, it could be argued that connecting two separate texts by means of a hyperlink would facilitate readers' detection of cross-text connections and, thus, improve integration across texts. Further, hyperlinks in texts may serve as signalling cues. Accordingly, a recent eye-tracking study found that the presence of hyperlinks encouraged rereading of the preceding text when the hyperlinked word was a low-frequency one (Fitzsimmons, Weal, & Drieghe, 2019, Experiment 3). Although Fitzsimmons and colleagues did not measure comprehension or memory for content, they argued that the presence of hyperlinks triggered increased processing of the information when highlighting difficult words or concepts (i.e., low frequency words). When reading multiple conflicting documents, signalling rhetorical relationships across texts has been found to facilitates readers' conflict detection and sourcing (Stadtler et al., 2014). Thus, linking conflicting texts through hyperlinks could be seen as a way of signalling cross-text connections and facilitate integration across texts that are spatially separated.

With respect to the detection of conflicting claims across separate texts, in particular, a specific claim encountered in one text would have to be retained or reinstated in working memory when readers encounter a conflicting claim in another text (Braasch & Bråten, 2017). Based on the previous discussion, two scenarios could be possible with regard to the use of hyperlinks and conflict detection. On the one hand, using hyperlinks may involve additional cognitive effort because the reader has to make strategic decisions, which could be detrimental to identifying and integrating conflicting information across separate documents. On the other hand, accessing conflicting information through hyperlinks could facilitate conflict detection because the presence of hyperlinks has been found to help learners identify and memorize relationships between different pieces of information. Thus, the use of hyperlinks could either disturb or facilitate conflict detection. As long as the

hyperlinks directly connect conflicting claims, however, they seem more likely to facilitate conflict detection, as compared to the reading of texts in a linear way.

## The present study

Given this background analysis, we took advantage of an essential characteristic of a hypertext environment (i.e., access to related information in other texts via hyperlinks) and created a support mechanism that might help readers co-activate conflicting claims from multiple texts simultaneously. Specifically, this mechanism provided readers with hyperlinks that, when selected, gave them access to popup balloons containing conflicting claims presented in other texts dealing with the same issue without leaving the currently read text. In accordance with the D-ISC model (Braasch & Bråten, 2017) and previous research framed by this model (e.g., Kammerer et al., 2016a; Stang Lund et al., 2017, 2019), we hypothesized that the extent to which readers accessed conflicting claims by means of these hyperlinks would determine their conflict detection and, in turn, construction of source-content links.

While all participants read conflicting claims in different texts that were not linked in the described way in addition to conflicting claims that were accessible via hyperlinks (i.e., in popup balloons), we did not expect the availability of linked claims per se but rather the extent to which participants accessed those claims via the links to be beneficial to conflict detection and source-content integration. This is because the availability of links in hypertext does not guarantee that readers actually use those links to access related information in other texts, with readers likely to vary considerably in their strategic approach to hypertext reading (Cho & Afflerbach, 2017). Indeed, people seem to show a moderate and even low tendency to click on hyperlinks. For example, Mukai, Bro, Fenger-Grøn, Olesen, and Vedsted (2012) found that only 45% of general practitioners clicked on a hyperlink that was inserted into a report that communicated the results of a cancer screening test applied to some of their patients as part of a national screening program. The use of hyperlinks was even lower in a study by Amichai-Hamburger, Kaynar, and Fine (2007), who found that the average number of links clicked on by their participants ranged from 0.56 to 1.08 (depending on the experimental condition) out of eight links on a commercial website that they had to read in order to decide whether to download a computer software.

Regarding the use of hyperlinks in the current study, we wanted to examine its effect on conflict detection in an ecologically valid situation in which decisions to click on the links were up to participants, as is usually the case when navigating on the Internet. Thus, in one experimental condition, participants were only told that the hyperlinks provided additional information. However, given the moderate-to-low level of hyperlink usage reported in previous studies (e.g., Amichai-Hamburger et al., 2007; Mukai et al., 2012) we also wanted to ensure that a substantial portion of the participants read the conflicting claims by clicking on the available links. Thus, to increase the likelihood that they selected the links, half of the participants were told that clicking on the links was necessary to gain a more complete understanding of the issue. In accordance with Britt, Rouet, and Durik (2018), we

hypothesized that this instruction would make these participants interpret the context and the task in a way that increased their selection of linked claims compared to participants who were just told that clicking on the links would give them more information (see *Procedure* below).

Finally, to best isolate variance resulting from the selection of links leading to conflicting claim in other texts, we also wanted to control for the individual difference variables of working memory capacity and prior knowledge about the issue in question. Our choice of these two covariates was based on previous findings indicating that working memory and topic knowledge may be associated with conflict detection as well as sourcing when students read multiple conflicting documents (e.g., Braasch, Bråten, Strømsø, & Anmarkrud, 2014; Salmerón, Gil, & Bråten, 2018; Stang Lund et al., 2019).

## Method

### Participants

Participants were 85 students at a university in southeast Norway, who were enrolled in bachelor (ranging from the 1st to the 4th year,  $n=77$ ) and master ( $n=8$ ) level programs in education, humanities, and social sciences. None of the study programs included any subject related to the topic discussed in the documents that were used in the present study. The sample included 64 females and 21 males who ranged in age from 19 to 47 years and had an overall mean age of 24.07 years ( $SD=5.27$ ). Most of the participants (77.7%) had Norwegian as their first language, and the rest were bilingual. In an international perspective, the sample was relatively homogeneous (i.e., middle class) with respect to socioeconomic status. Collection and handling of all data met the requirements of the Personal Data Registers Act and were approved by the Norwegian Social Science Data Services.

## Materials

### Documents and experimental manipulations

Each participant read four separate documents on the controversial issue of sun exposure and health. These documents were adapted versions of the documents previously used by Stang Lund et al. (2017, 2019). At the beginning of each document, just above the title, source information was presented in the form of author's name, credentials, and affiliation, as well as publication venue and date of publication. Title and source information for each of the four documents are presented in the Appendix. The four documents ranged in length from 322 to 386 words ( $M=349.25$ ,  $SD=26.94$ ), with readability scores based on Björnsson's (1968) formula ranging from 41 to 45 ( $M=42.50$ ,  $SD=1.91$ ), indicating a difficulty level comparable to that of information texts from the Norwegian government (Vinje, 1982).

One pair of documents concerned sun exposure and mental health and another pair of documents concerned sun exposure and physical health. Thus, the pair of documents concerning mental health consisted of one document describing lack of light as a cause of depression and one document describing lack of light as a cause of sleeplessness (rather than depression). The pair of documents concerning physical health consisted of one document describing negative effects sun exposure in terms of increased risk of skin cancer and one document describing positive effects of sun exposure in terms of increased production of vitamin D (which can protect against cancer).

Each of the four documents consisted of four paragraphs. Each of the four paragraphs presented a claim that was in conflict with a claim presented in a paragraph of the other document within the same pair. For example, in the two documents concerning mental health, it was said in one of the paragraphs of the document describing lack of light as a cause of depression that more Norwegians are suffering from winter depression than people living closer to equator, whereas it was said in one of the paragraphs of the document describing lack of light as a cause of sleeplessness that the prevalence of depression among Norwegians is not higher than among people living further south (e.g., Italians). In an example from the pair of documents concerning physical health, it was said in one paragraph of the document describing negative effects that use of sunbeds may substantially increase the risk of getting cancer, whereas it was said in one of the paragraphs of the document describing positive effects that weekly use of sunbeds during the winter may protect against cancer (due to vitamin D production).

The existence of hyperlinks giving access to conflicting claims was manipulated within participants, such that each participant read each document with two of the four claims that were in conflict with claims in another document linked to those claims, whereas the other two claims that were in conflict with claims in another document were not linked to those claims. Which of the four claims in a document were linked to conflicting claims in another document and which were not was counterbalanced across participants. Of note is that hyperlinks were always embedded at the end of a paragraph, that is when the pertinent claim in that paragraph was fully explained, in order to disturb the processing of the content as little as possible.

When clicking on a link, the conflicting claim in another document “popped up” in a balloon that covered the text in such a way that the participant had to close it in order to continue reading. The information presented in the balloons for a particular document were taken verbatim from the other document in the same pair, and included source information and the conflicting claims, as well as explanations or elaborations of those claims, with the content of the balloons varying in length from 27 to 78 words ( $M=49.69$ ,  $SD=15.60$ ). Please see *Procedure* below for further information about the hypertext application.

In addition, we manipulated the task instructions between participants. All participants were asked to read the documents in order to learn about the topic, so that they could answer some questions about it afterwards. In one instructional condition, half of the participants (randomly assigned) also were informed in writing that they should notice the links within the texts and that clicking on these links would give them more information. We termed this instructional condition the “weak prompting



condition.” In another condition termed the “strong prompting condition,” the other half of the participants were additionally told that to get a more complete understanding of the discussion surrounding sun exposure and health, it was necessary that they click on the links. Presumably, the strong prompting condition would further increase the perceived utility value (Wigfield & Eccles, 2000) of clicking on the links and thereby motivate participants to access conflicting claims via the popup balloons.

## Dependent measures

To assess the effects of clicking on linked claims, we adapted two measures that have been used and validated in previous research: the conflict verification task designed by Stadtler and colleagues (Stadtler et al., 2014; Stadtler, Scharrer, Brummernhenrich, & Bromme, 2013) and the source-content integration task designed by Strømsø and colleagues (Strømsø, Bråten, & Britt, 2010).

### Conflict verification task (CVT)

To assess the extent to which participants had detected conflicting claims across documents, we used an adapted version of the CVT recently used and validated by Stang Lund et al. (2017, 2019). This measure is derived from Stadtler et al.’s (2013, 2014) original, German version of the task. The CVT consisted of 20 statements that were followed by two questions each. The first question was “Is this claim consistent with what you read in one of the texts?” The second question was “Did you read anything in one of the other texts that is in conflict with this claim?” Each question had to be answered “yes” or “no”. Eight of the 20 statements were paraphrases of textual claims that conflicted with a claim presented in another document (i.e., another document within the same pair of documents). In accordance with Stadtler et al. (2013), we termed such items “attractor items.” Eight other items were paraphrases of textual claims that did not conflict with a claim presented in another document. In accordance with Stadtler et al. (2013), we termed such items “uncritical items.” Two attractor items and two uncritical items were taken (i.e., paraphrased) from each of the four documents. The four remaining statements were claims about health issues that were not presented in any of the documents; nor were they in conflict with any other claim presented in the documents. Following Stadtler et al. (2013), we termed such items “distractor items.”

We followed the scoring procedure used in prior research with this task (Keck, Kammerer, & Starauschek, 2015; Stadtler et al., 2013, 2014; Stang Lund et al., 2017, 2019), thus correcting for a tendency to answer the questions in the positive. This means that participants’ scores were based on the difference between the proportion of the attractor items for which both questions were answered “yes” and the proportion of the uncritical items for which both questions were answered “yes” (i.e., false positives). Theoretically, scores on the CVT could thus range from  $-1$  (none of the attractor items were correctly identified as conflicting claims and all of the uncritical items were incorrectly identified as conflicting claims) to  $1$  (all of the attractor items

were correctly identified as conflicting claims and none of the uncritical items were incorrectly identified as conflicting claims).

In addition to a total score based on all of the attractor and uncritical items, we computed a separate score based on the attractor items referring to claims that were linked in the hypertext environment (four for each participant) plus the eight uncritical items. Also, we computed a separate score based on the attractor items referring to claims that were not linked in the hypertext environment (four for each participant) plus the eight uncritical items. The reliability estimate (Cronbach's  $\alpha$ ) for participants' scores on the CVT was .66.

### Source-content integration task (SCIT)

To measure participants' representation of source-content links, we used a task targeting their ability to connect document contents with the respective sources. This was an adaptation of a task that has been used to measure sourcing performance in much prior multiple document research (Kammerer, Meier, & Stahl, 2016; Stang Lund et al., 2017, 2019; Strømsø et al., 2010). Participants were presented with four text sentences, one from each of the four documents, together with four distractor sentences. Each of the four text sentences taken from the documents presented key information from the corresponding document. The content of the four distractor sentences was not covered in any of the documents but was related to the topic of sun exposure and health.

Each of the eight sentences was accompanied by five letters (A–E). Each of the first four letters (A–D) represented one of the sources and the last letter (E) represented the alternative that the content of the sentence did not come from any of the sources. The five optional letters were explained in the instruction by linking each of them to the source of a particular document or to information not found in any of the documents (e.g., A: Chief physician Hilde Dahl, The Norwegian Cancer Association, *Journal of Medicine*, 2014; E: Information not located in anything you read). Participants were instructed to mark each key sentence with the correct letter (A–D) to indicate the source of the information, or, alternatively, to mark a sentence E if the information did not come from any of the sources. One point was awarded for each of the eight items that participants marked correctly. The reliability estimate (Cronbach's  $\alpha$ ) for participants' scores on the SCIT was .63.

## Covariates

### Working memory measure

Working memory was measured with a Norwegian adaptation of Swanson and Trahan's (1992) Working Memory Span Task that has been used and validated in prior research (Andresen, Anmarkrud, & Bråten, 2019; Braasch et al., 2014). This measure is derived from Daneman and Carpenter's (1980) original Reading Span Test. The measure was group administered, with 12 sets of unrelated sentences read aloud with a 2-second interval between each sentence. The sets gradually increased from

two to five sentences. Participants were asked to simultaneously (a) answer a comprehension question about an unknown sentence after the final sentence was read, and (b) remember the final words from each of the sentences. For each of the 12 trials, participants received 1 point if they correctly answered the comprehension question and one additional point for each of the final words they recalled. If participants did not answer the comprehension question correctly, they were not awarded any points for that set irrespective of how many final words they recalled. Cronbach's  $\alpha$  for participants' scores on this measure was .70.

### Topic knowledge measure

Participants' prior knowledge about the topic of sun exposure and health was assessed with a 24-item multiple-choice measure. This measure also has been used and validated in prior research (e.g., Bråten, Anmarkrud, Brandmo, & Strømsø, 2014; Stang Lund et al., 2019). The items referred to concepts and information central to the issue of sun exposure and health that were discussed in the four documents. As such, the topic knowledge measure covered aspects of the issue that were related to both mental and physical health (e.g., depression, sleeplessness, skin cancer, and production of vitamin D). Participants' scores were the number of correct responses out of 24. The reliability estimate (Kuder-Richardson 20) for scores on the topic knowledge measure was .59. Although this internal consistency reliability is lower than desirable, presumably because diverse knowledge aspects were included in the measure, it may still be considered acceptable for research purposes (Hair, Black, Babin, Anderson, & Tatham, 2006; Kerlinger & Lee, 2000).

### Procedure

Data were collected in one 60-min session in a computer lab at the university, with all materials administered by the first and second authors in groups of maximum 11 participants. First, participants completed a brief demographic survey, the working memory measure, and the topic knowledge measure in this order. These measures were completed on paper. When finished, participants accessed a web based application program created for this study that had been installed on the computers in the lab. On the first page of the application, displayed on a 24" monitor, participants were informed that they should read some texts on a website but that they first need to read an instruction carefully, which was available by clicking on a button in the center of the page. On the page containing the task instruction, all participants read:

You are now going to read four different expository texts about sun and health on a website. When you have read the texts, we will give you some questions to see what you have learned. Please notice the links within the texts. By clicking on these links, you will get more information.

For participants randomly assigned to the strong prompting condition, the instruction continued:

To get a more complete understanding of the discussion surrounding sunlight and health, it is necessary that you click on the links.

After having read the task instruction, participants clicked on a “start reading” button to access a website purportedly retrieved from forskning.no, which is an online research magazine published by a group of educational institutions. This website introduced the topic in this way:

The relationship between sunlight and health is much discussed. Many researchers are concerned about how being in the sun, or the lack of sunlight, affects our health. Some discuss the sun’s effect on our physical health, while others are concerned about its effect on mental health. Here you can read about this important topic in four articles that are published in different journals and on different websites.

In addition, this website contained a menu vertically listing the four documents by displaying the name of the author and the title of the document (in this order) for each document, with the documents accessible through hyperlinks located in the titles. The conflicting issue of sun exposure and physical health and the conflicting issue of sun exposure and mental health were presented in counterbalanced order in the menu, as were the two documents dealing with each of these issues.

Clicking on a document title displayed that document in its entirety, that is, without any scrolling. The resolution was 96 dpi and the font size was 16 pixels, which is equivalent to 12-point size. As described in the *Materials* section, each document contained two claims that were linked to conflicting claims in another document via popup balloons, whereas two other claims that were in conflict with claims in another document were not linked to those claims, with the claims that were linked versus not linked counterbalanced across participants. Key words in the linked claims were in blue to signal the existence of hyperlinks, with those words turning purple after being clicked on by participants.

The popup balloon that appeared when clicking on a linked claim contained not only the conflicting claim in another document but also the source of the conflicting claim (i.e., author’s name and affiliation plus publication venue), with this source information presented above the conflicting claim. Participants had to close the balloon by clicking on a “close” button in the bottom-right corner of the balloon to be able to read further in the current document (see Fig. 1). The number of times each participant clicked on linked claims and accessed the corresponding popup balloons were logged by the application. When finishing a document, participants clicked on a “return” button that brought them back to the menu page from which they could access the other documents. Of note is that the four documents were accessible only from the menu page because the hyperlinks embedded within a document, when clicked on, did not lead participants to another document but only had the balloons with conflicting claims from that document pop up.



Fig. 1 Screenshot of a document with an activated popup balloon

When participants had finished reading the documents, they clicked on an “I have finished” button in the bottom-right corner of the menu page, after which they were asked on a final page whether they were sure they had read all four documents or whether they wanted to go back to the menu page and continue reading. When confirming that they were finished reading the documents, the application was closed and participants received a folder containing the SCIT and the CVT, which they completed on paper. The order of these two tasks was determined by our effort to minimize measurement reactivity (French & Sutton, 2010).

## Results

Descriptive statistics for all measured variables are displayed in Table 1. As can be seen, the descriptive data were approximately normally distributed and, as such, suitable for parametric statistical analyses. Participants' average scores on the CVT and the SCIT were comparable to those obtained in prior research using these measures in multiple document contexts (Kammerer et al., 2016b; Stadler et al., 2014; Stang Lund et al., 2017, 2019; Strømsø et al., 2010).

Table 2 shows zero-order correlations between the measured variables, with instructional condition (i.e., weak vs. strong prompting) also included in the correlation matrix. As can be seen, instructional condition was not statistically

**Table 1** Descriptive statistics for all measured variables

Variable	<i>M</i> ( <i>SD</i> )	Skewness ( <i>SE</i> )
Working memory	29.60 (10.54)	-.27 (.26)
Topic knowledge	18.13 (3.03)	-.33 (.26)
Clicks on linked claims	4.28 (3.55)	-.23 (.26)
Score on CVT items referring to linked claims)	0.43 (0.35)	-.30 (.26)
Score on CVT items referring to unlinked claims)	0.39 (0.35)	-.56 (.26)
Score on CVT (total)	0.41 (0.31)	-.40 (.26)
Score on SCIT	5.22 (1.86)	-.01 (.26)

**Table 2** Zero-order correlations between instructional condition and measured variables

Variable	1	2	3	4	5	6	7	8
1. Instructional condition	–							
2. Working memory	-.049	–						
3. Topic knowledge	-.043	.223*	–					
4. Clicks on linked claims	.006	.294**	.377***	–				
5. Score on CVT items on linked claims	.024	.151	.289**	.354**	–			
6. Score on CVT items on unlinked claims	.141	.159	.229*	.155	.520***	–		
7. Score on CVT (total)	.095	.178	.297**	.291**	.870***	.873***	–	
8. Score on SCIT	.148	.104	.290**	.320**	.354**	.299**	.374***	–

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

significantly related to any of the measured variables. Most notably, the relationship between instructional condition and number of clicks on linked claims was close to zero ( $r = .006$ ,  $p = .958$ ), indicating that participants in the strong prompting condition were not more likely to access conflicting claims through available links than were participants in the weak prompting condition. In fact, the mean number of linked claims that participants clicked on in each instructional condition was quite similar (weak prompting:  $M = 4.262$ ,  $SD = 3.472$ ; strong prompting:  $M = 4.302$ ,  $SD = 3.661$ ). In all, 30 participants did not click on any of the linked claims, with these participants equally distributed across the two instructional conditions,  $X^2 < 1$  (weak prompting:  $n = 14$ ; strong prompting:  $n = 16$ ). Additionally, participants rarely re-clicked on links regardless of the instructional condition, and the number of participants that re-clicked at least once did not differ statistically significantly across the conditions,  $X^2(1, N = 85) = 1.012$ ,  $p = .315$  (weak prompting:  $n = 7$ ; strong prompting:  $n = 11$ ). Nor did the number of re-clicks differ across the instructional condition,  $F < 1$  (weak prompting:  $M = 1.286$ ,  $SD = 0.488$ ; strong prompting:  $M = 1.454$ ,  $SD = 0.522$ ). Given that our task instruction manipulation did not have any effect on participants' clicking

behavior, this variable was not included in subsequent statistical analyses. We will return to this finding, which was not consistent with our hypothesis, in the Discussion section.

It can also be seen in Table 2, however, that the number of times participants clicked on linked claims was positively correlated with their scores on the CVT ( $r = .291, p = .007$ ). Of note is that this correlation was due to the relationship with the conflict verification scores based on items referring to linked claims ( $r = .354, p = .001$ ), suggesting that reading conflicting claims through the hyperlinks facilitated participants' conflict detection. Moreover, the number of times participants clicked on linked claims was statistically significantly correlated with their scores on the SCIT ( $r = .320, p = .003$ ), suggesting that accessing conflicting claims across texts via the popup balloons facilitated participants' representation of source-content links. Conflict verification scores based on items referring to linked claims were positively correlated with scores on the SCIT ( $r = .354, p = .001$ ), as were conflict verification scores based on items not referring to linked claims ( $r = .299, p = .005$ ) and total conflict verification scores ( $r = .374, p < .001$ ). Both working memory ( $r = .294, p = .006$ ) and topic knowledge ( $r = .377, p < .001$ ) were positively correlated with the number of times participants clicked on linked claims, but only topic knowledge was statistically significantly related to participants' scores on the CVT (both for items referring to linked claims,  $r = .289, p = .007$ , and for items referring to unlinked claims,  $r = .229, p = .035$ ) and the SCIT ( $r = .290, p = .007$ ).

### **The effect of accessing conflicting claims through hyperlinks on conflict detection**

We conducted a series of analyses of covariance (ANCOVAs) to examine the effect of accessing the conflicting claims by means of the hyperlinks on participants' conflict detection. ANCOVA assumptions were met in all cases. We first performed a repeated-measures ANCOVA on the CVT scores with the linking manipulation as a within-participants variable and topic knowledge as a covariate. Results indicated that the scores on the CVT items referring to linked claims ( $M = .43, SD = .35$ ) and the scores on the CVT items referring to unlinked claims ( $M = .39, SD = .35$ ) were similar,  $F < 1$ . Given that 30 participants did not click on any of the linked claims, we further analyzed the effect of reading the conflicting claims through hyperlinks in a subsample of participants consisting of those who clicked on all linked claims ( $n = 47$ ). Performing the same repeated-measures ANCOVA with this subsample did also not result in any statistically significant difference between the scores on the CVT items referring to linked claims ( $M = .52, SD = .33$ ) and scores on the CVT items referring to unlinked claims ( $M = .43, SD = .33$ ),  $F < 1$ .

Finally, we examined the effect of accessing the conflicting claims by means of the hyperlinks on participants' conflict detection and source-content integration by splitting the sample into two sub-groups, consisting of those participants who did not click on any of the linked conflicting claims ( $n = 30$ ) and those who clicked on all of those claims ( $n = 47$ ). We then conducted a mixed ANCOVA on the CVT scores with these two sub-groups as a between-participants factor (coded 0 for participants who did not click on any of the linked claims, and 1 for participants who clicked on

all the linked claims) and the linking conditions (i.e., CVT items referring to linked claims vs. CVT items referring to unlinked claims) as a within-participants factor. Although the scores on the CVT items referring to linked claims were higher, especially among those who clicked on all linked claims (see Table 3), no main effect of the linking conditions,  $F < 1$ , no main effect of the sub-groups,  $F(1, 74) = 1.97$ ,  $p = .16$ , or no interaction effect between these two variables,  $F(1, 74) = 1.35$ ,  $p = .25$ , was found.

### The effect of accessing conflicting claims through hyperlinks on source-content integration

We also examined the effect of accessing the conflicting claims by means of the hyperlinks on the scores on the SCIT by conducting an ANCOVA controlling for participants' topic knowledge. Again, we used the dichotomous variable constructed by splitting the sample into those who clicked on all the linked claims and those who did not click on any linked claims as an independent variable. ANCOVA assumptions were met. Results showed that those who clicked on all the linked claims scored statistically significantly higher on the SCIT ( $M = 5.77$ ,  $SD = 1.76$ ) than did those who did not click on any of these claims ( $M = 4.53$ ,  $SD = 1.94$ ),  $F(1, 74) = 4.33$ ,  $p = .04$ ,  $\eta_p^2 = .06$ .

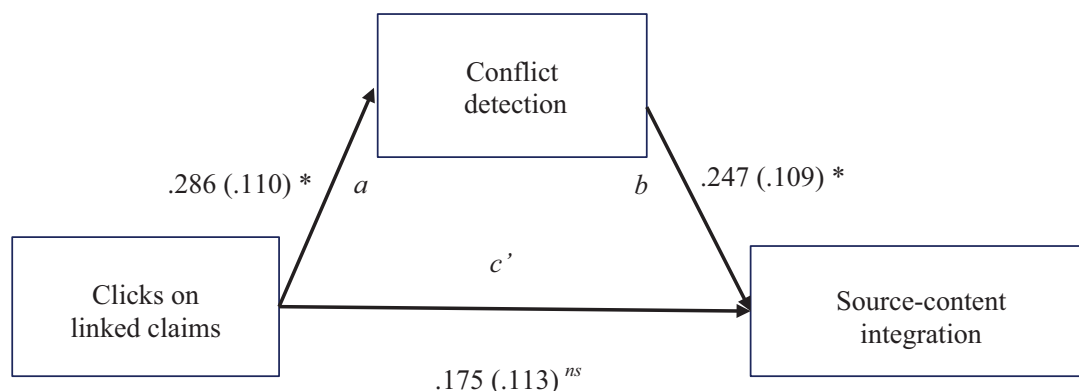
### Mediation effect of conflict detection on source-content integration

The correlational pattern as well as the results reported above allowed us to test the hypothesis that conflict detection would mediate the effect of accessing conflicting claims by means of hyperlinks on source-content integration. Thus, the extent to which participants clicked on linked claims was positively related to conflict detection as well as to source-content integration, and conflict detection also was positively related to source-content integration. The mediational analysis was performed by means of a bootstrap estimation approach with 1000 samples (Preacher & Hayes, 2008), including conflict verification based on items referring to linked claims as a mediating variable and topic knowledge as a covariate. The results of this analysis are displayed in Fig. 2. The model accounted for a statistically significant portion of the variance,  $R^2 = .188$ ,  $F(3, 81) = 6.249$ ,  $p < .001$ . Consistent with our hypothesis, the bootstrapped results showed a positive statistically significant indirect effect of clicking on linked claims on source-content integration via conflict detection, yielding an estimate of 0.071 ( $CI_{95\%}$  0.003–0.213). As can be seen in Fig. 1, the direct

**Table 3** Mean scores (SD) on the conflict verification task (CVT) for participants who clicked on all the linked claims and participants who did not click on any of the linked claims

	Linked CVT items	Unlinked CVT items
Clicked on all linked claims	.43 (.33)	.52 (.33)
Did no click any linked claim	.32 (.33)	.33 (.40)





**Fig. 2** Mediation model for the effect of clicks on linked claims on source-content integration with conflict detection as a mediator (standardized coefficients). \* $p < .05$

effect of clicking on source-content integration was not statistically significant,  $b = 0.175$ ,  $SE = 0.113$ ,  $p = .123$ ), which is consistent with a full mediation. Finally, the covariate of topic knowledge ( $b = 0.153$ ,  $SE = 0.110$ ,  $p = .168$ ) was not a statistically significant predictor in this analysis.

## Discussion

This study uniquely contributes to the area of multiple document literacy by investigating conflict detection and sourcing in a hypertext environment where conflicting claims across documents were accessible through hyperlinks. As hypothesized, the results showed that accessing conflicting claims in another document by clicking on hyperlinks embedded within the currently read document may improve readers' conflict detection and, in turn, their construction of source-content links. However, participants who were informed that clicking on the links was necessary to gain a more complete understanding of the issue were not more likely to do so than were participants who were just told that clicking on the links would give them more information. In the following, we discuss theoretical and practical implications of our research, note limitations, and suggest some avenues for future work in this area.

The finding that accessing the conflicting claims by means of the hyperlinks improved source-content integration, and that this effect is mediated by conflict detection, is consistent with the D-ISC model of Braasch and colleagues (Braasch et al., 2012; Braasch & Bråten, 2017). Thus, in light of this model, one likely explanation for our finding is that accessing conflicting claims in different documents via the hyperlinks facilitated the co-activation of such claims in working memory, leading to experiences of cognitive conflicts and attention to the sources of the respective claims in an effort to restore coherence. Importantly, this study thus suggests that core assumptions of the D-ISC model can be confirmed in a reading context where multiple documents are connected via hyperlinks, extending the applicability of this model from more simplistic reading contexts to a context that is currently ubiquitous both in and out of school.

We consider the finding that using embedded hyperlinks in multiple document contexts may have positive outcomes, such as increased source-content integration, far from trivial. Although applauded by some theorists (e.g., Jacobson & Spiro, 1995; Spiro et al., 2015), navigation across hyperlinked information in multiple documents has been shown to be as likely to promote fragmentation as integration (e.g., DeStefano & LeFevre, 2007; Niederhauser, Reynolds, Salmen, & Skolmoski, 2000). Presumably, the positive outcomes observed in this study were due to the fact that selection of the hyperlinks reduced the demands on participants' working memory resources rather than the opposite, which may be the case in other situations where readers try to understand an issue by navigating across hyperlinked texts (DeStefano & LeFevre, 2007). This also implies that the hypertext environment that we created in this study may function as a support mechanism that facilitates working memory co-activation of information during multiple document reading. Accordingly, our findings may have practical value in addition to their theoretical significance.

Of course, this practical value is tied to the particular type of hypertext links that were constructed in this study. These links activated popup balloons that gave readers access to conflicting information in other documents without leaving the meaning context of the currently read document. Such popups in the form of small windows or balloons that can be activated by "mousing over" or clicking on the links are implemented in common websites such as Wikipedia, with linked information also presenting different perspectives on the same topic, but they have to a limited extent been examined with regard to potential learning outcomes. That said, Antonenko and Niederhauser (2010) found that accessing mouse-over balloons providing previews of related information in linked hypertext nodes reduced cognitive demands and improved knowledge acquisition among adult readers. In a similar vein, it has been reported that allowing readers to simultaneously access two documents in a two-window software can help them align their post-reading summaries with the texts' content, as compared to reading the texts in two alternating windows (Olive, Rouet, Francois, & Zampa, 2008, Experiment 2). Also, Wiley (2001) found that a two-window web browser (vs. a traditional single-window browser) fostered readers' integration of the content of multiple web sites when the task required such integration.

The present study provides evidence to suggest that popup balloons or windows also may support integration when working with multiple conflicting documents, that is, when they give readers access to conflicting information presented across documents. Presumably, one distinct advantage of popup balloons or windows compared to other types of embedded hyperlinks is that they do not transport readers to a different page but, rather, allow them to continue reading the current document as soon as the balloon or window is closed. In this way, disturbance of the process of within-document integration, as a basis for cross-document integration (List & Alexander, 2019), seems less likely when such popup balloons or windows are used.

An interesting question is why our manipulation of the task instructions did not produce the expected result. While prior research in both single and multiple document contexts (e.g., Bråten, Gil, & Strømsø, 2011; Linderholm, 2006; Salmerón, Kintsch, & Kintsch, 2010) has indicated that task instructions may influence readers' text processing, including hypertext selection, as well as outcomes, including

integration, adding the information that clicking on the links was necessary to gain a more complete understanding of the issue did not increase participants' selection of available links in this study. One possible reason is that the difference between the two task conditions (i.e., the weak and strong prompting conditions) was not sufficiently pronounced, with participants in the weak prompting condition also told that they would get more information by clicking on the links. Given this possibility, future studies could explore the influence of prompting participants to click on the hyperlink by including a control group in which participants are not told anything about the usefulness of the hyperlinks. However, another possible explanation is that because participants worked with these documents in an experimental setting that did not really matter for them, and where they did not expect to be held accountable for learning or comprehension in any way, gaining a more complete understanding of the issue was not a goal they adopted despite the strong prompting. As noted by Bråten, Brante, and Strømsø (2018), such lack of reader engagement may be considered a limitation of much current multiple document research. In this regard, future research should pay more attention to the interestingness of the topic to the population in question when designing a multiple text scenario.

This is not the only potential limitation of our study, of course. For example, the generalizability of our findings may be limited by the particular sample, including a majority of female students of education and humanities, and the particular topic that we used. In addition, although conflict verification and source-content integration can be considered essential aspects of multiple document literacy (Braasch & Bråten, 2017; Bråten & Braasch, 2018), we did not include any outcome measure to assess participants' comprehension of the issue of sun exposure and health in the current research. It could also be argued that the effect of accessing the hyperlinks on source-content integration might be due to a third variable affecting both navigation and integration (Salmerón & Garcia, 2011; Salmerón, Garcia, & Vidal-Abarca, 2018). In this study, we tried to minimize this possibility by controlling for the potential effects of relevant individual difference variables such as working memory and topic knowledge.

Finally, given the design of the study, we cannot rule out the possibility that the beneficial effects of accessing the popup balloons, at least in part, were due to the fact that participants simply read the conflicting claims more times, rather than to the simultaneous presentation of conflicting claims across documents. Future researchers should therefore try to control for the number of times participants read conflicting claims that are hyperlinked via popup balloons and conflicting claims that are not hyperlinked in this way. Also, future research could explore whether accessing conflicting claims via hyperlinks elicits conflict detection to a greater extent than reading conflicting claims in texts that are not linked in this way. To that end, think-aloud and self-explanation methodologies (e.g., Cho, 2014) could serve as appropriate methods for tracking readers' activation of conflicting claims previously read and their awareness of the existence of conflicting information.

Despite such limitations, we are enthusiastic about the new avenues for future research our study may offer. In addition to further probing the generalizability of our findings with other samples and topics, measuring multiple document comprehension more broadly, and trying to clarify the potential effect of just reading

the conflicting claims over again, the usefulness of popup balloons or windows for promoting multiple document reading skills, including sourcing and inter-textual integration, is an issue wide open for future research. For example, our findings may inspire the development of computer based tutoring systems centering on a similar support mechanism, with the testing of such systems over time potentially catalyzing theoretical refinement as well as practical guidance within multiple document literacy. Further research on how various task instructions are interpreted by readers and how they may differentially influence processing and outcomes (cf., Britt et al., 2018) could also be conducted as part of such intervention studies.

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## Appendix: Title and source information for each of the four texts

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### Lack of light causes depression

Psychologist Anita Lund  
 Association for Mental Health  
 Helsenorge.no\*  
 2016

### Too little daylight leads to sleeplessness

Lecturer Kristin Iversen  
 Norwegian School of Sports Sciences  
 Olympiatoppen.no\*\*  
 2013

### Sunbathing causes cancer

Chief physician Hilde Dahl  
 The Norwegian Cancer Association  
 Journal of Medicine  
 2014

### Vitamin D is important for the body

Nutritionist Nina Sørensen  
 Norwegian Food Safety Authority  
 Journal of Food and Health  
 2015

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\*A Norwegian public health information website

\*\*The website of the Norwegian Olympic and Paralympic Committee and Confederation of Sports

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## **Appendix**

Approval of project from Norwegian Social Science Data Services



Elisabeth Stang Lund  
Christies gate 13  
5020 BERGEN

Vår dato: 01.02.2018

Vår ref: 58668 / 3 / HJT

Deres dato:

Deres ref:

## Vurdering fra NSD Personvernombudet for forskning § 31

Personvernombudet for forskning viser til meldeskjema mottatt 30.01.2018 for prosjektet:

<i>58668</i>	<i>Bruk av hyperlenker i lesning av digitale tekster</i>
<i>Behandlingsansvarlig</i>	<i>Universitetet i Oslo, ved institusjonens øverste leder</i>
<i>Daglig ansvarlig</i>	<i>Elisabeth Stang Lund</i>

### Vurdering

Etter gjennomgang av opplysningene i meldeskjemaet og øvrig dokumentasjon finner vi at prosjektet er meldepliktig og at personopplysningene som blir samlet inn i dette prosjektet er regulert av personopplysningsloven § 31. På den neste siden er vår vurdering av prosjektopplegget slik det er meldt til oss. Du kan nå gå i gang med å behandle personopplysninger.

### Vilkår for vår anbefaling

Vår anbefaling forutsetter at du gjennomfører prosjektet i tråd med:

- opplysningene gitt i meldeskjemaet og øvrig dokumentasjon
- vår prosjektvurdering, se side 2
- eventuell korrespondanse med oss

Vi forutsetter at du ikke innhenter sensitive personopplysninger.

### Meld fra hvis du gjør vesentlige endringer i prosjektet

Dersom prosjektet endrer seg, kan det være nødvendig å sende inn endringsmelding. På våre nettsider finner du svar på hvilke [endringer](#) du må melde, samt endringskjema.

### Opplysninger om prosjektet blir lagt ut på våre nettsider og i Meldingsarkivet

Vi har lagt ut opplysninger om prosjektet på nettsidene våre. Alle våre institusjoner har også tilgang til egne prosjekter i [Meldingsarkivet](#).

### Vi tar kontakt om status for behandling av personopplysninger ved prosjektslutt

Ved prosjektslutt 23.02.2018 vil vi ta kontakt for å avklare status for behandlingen av personopplysninger.

*Dokumentet er elektronisk produsert og godkjent ved NSDs rutiner for elektronisk godkjenning.*

Se våre nettsider eller ta kontakt dersom du har spørsmål. Vi ønsker lykke til med prosjektet!

Marianne Høgetveit Myhren

Håkon Jørgen Tranvåg

Kontaktperson: Håkon Jørgen Tranvåg tlf: 55 58 20 43 / [Hakon.Tranvag@nsd.no](mailto:Hakon.Tranvag@nsd.no)

Vedlegg: Prosjektvurdering



## Prosjektvurdering - Kommentar

---

Prosjektnr: 58668

Du har opplyst i meldeskjema at prosjektet er en internasjonal samarbeidsstudie, hvor Universitetet i Oslo er behandlingsansvarlig for den norske delen av prosjektet. Personvernombudet forutsetter at ansvaret for behandlingen er avklart mellom institusjonene, og anbefaler at dere inngår en avtale som omfatter ansvarsfordeling, hvem som initierer prosjektet, bruk av data, eventuelt eierskap.

Du har opplyst i meldeskjema at utvalget vil motta muntlig informasjon om prosjektet, og samtykke muntlig til å delta. Vi gjør oppmerksom på at for å innhente et gyldig samtykke må utvalget minst motta følgende informasjon:

- hva som er formålet med prosjektet og hva opplysningene vil bli brukt til
- hvilke opplysninger som samles inn og hvordan opplysningene samles inn
- at deltakelse i prosjektet er frivillig, og at man kan trekke seg uten begrunnelse
- hvem som vil få tilgang til opplysningene
- når prosjektet vil bli avsluttet og hva som vil skje med opplysningene ved prosjektslutt; opplysningene anonymiseres, slettes eller lagres/arkiveres
- navn og kontaktopplysninger til behandlingsansvarlig institusjon
- navn og kontaktopplysninger til den daglig ansvarlige for prosjektet, samt til studenten ved studentprosjekt

Personvernombudet forutsetter at du behandler alle data i tråd med Universitetet i Oslo sine retningslinjer for datahåndtering og informasjonssikkerhet.

Prosjektslutt er oppgitt til 23.02.2018. Det fremgår av meldeskjema/informasjonskriv at du vil anonymisere datamaterialet ved prosjektslutt.

Anonymisering innebærer vanligvis å:

- slette direkte identifiserbare opplysninger som navn, fødselsnummer, koblingsnøkkel
- slette eller omskrive/gruppere indirekte identifiserbare opplysninger som bosted/arbeidssted, alder, kjønn

For en utdypende beskrivelse av anonymisering av personopplysninger, se Datatilsynets veileder:

<https://www.datatilsynet.no/globalassets/global/regelverk-skjema/veiledere/anonymisering-veileder-041115.pdf>