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MAKING UP YOUR MIND ABOUT A COMPLEX TECHNOLOGY

An investigation into factors that help or hinder the achievement of cognitive closure about CCS

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Making Up Your Mind About a Complex Technology:
An Investigation into Factors That Help or Hinder the Achievement of Cognitive Closure About CCS

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Chapter 1

Helps and Hindrances to the Achievement of Cognitive Closure About CCS

General Introduction, Discussion, and Conclusions

Modern day society is increasingly characterized by complex technological innovations. New developments, such as climate engineering, nanotechnology, and robotics are presented to the world almost on a daily basis. Many of these innovations impact to some degree on people's lives and it is hence not surprising that the implementation of complex technologies can generally only succeed with acceptance, participation, or support of the general public (e.g., Dütschke, 2011; Markusson, Ishii, & Stephens, 2011; Read, Brown, Thorsteinsson, Morgan, & Price, 2013; Terwel, Ter Mors, & Daamen, 2012). Taking this influence of the public into account, those involved with the implementation of a complex technology often show an interest in the public's opinion on the technology and attempt to inform themselves of people's viewpoint by means of, for instance, opinion polling or interviews.

People are generally willing to declare their "attitude" towards the utilization of a complex technology, even when their knowledge of the topic is low, or the formation of their attitude towards the topic has not yet been completed (De Best-Waldhober, Daamen, & Faaij, 2009; also see Bishop, Oldendick, Tuchfarber, & Bennet, 1980; Scheufele & Lewenstein, 2005). However, such unfinished, open attitudes, or pseudo-attitudes, are very unstable and therefore hardly predictive of actual levels of support for or opposition to the technology in question (e.g., De Best-Waldhober et al., 2009). Finishing the formation of an attitude, or forming a "closed attitude", on a particular topic is known as achieving cognitive closure. Attitudes about which people have achieved a state of cognitive closure are known to be more stable and more predictive of actual behavior than open attitudes. Accordingly, such closed attitudes are also better predictors of subsequent support for (acceptance of) versus opposition to (protest against) the issue at stake (cf. Bassili, 1996; Fazio & Zanna, 1978; Krosnick & Petty, 1995; Petty & Cacioppo, 1986b). Thus, for the purpose of understanding public opinion regarding the implementation of complex or novel technologies, and the unfolding thereof, it is of great interest to know which factors relate to the achievement of cognitive closure.

Previous research on the achievement of cognitive closure has predominantly addressed the role of differences in the degree to which people experience a *need* for closure (e.g., Kruglanski, 1989, 1990; Kruglanski & Webster, 1991, 1996; Webster & Kruglanski, 1994, 1997). This perspective emphasizes that people tend to differ in their overall desire for definite answers to different issues (i.e., for cognitive closure) and that this desire affects the likelihood that they draw a conclusion about the topic at hand, and hold on to this conclusion. Generally speaking, people with a high need for closure feel more inclined to achieve closure quickly and to stick with this closure, compared to those with a lower need for closure. Thus, research on the need for closure has provided

important insights showing that people can differ in their overall tendency to form a closed attitude. Nevertheless, there may also be other factors that determine whether or not people achieve cognitive closure. Especially when it comes to forming a closed attitude about the implementation of a complex technology, people may be restricted in their *ability* to achieve closure—regardless of their basic need or desire for closure. In fact, whether people think it will be difficult or easy to achieve closure—in other words; whether they feel *capable* of achieving closure—may be as important as whether they want to or feel the need to achieve closure. Indeed, people are likely to be aware of the intricate and multi-faceted nature of issues such as the implementation of a complex technology, and realize it may not be easy or even feasible to fully grasp or weigh all the aspects that might be relevant to deciding on a particular point of view. For many, achieving closure on such issues is, as a result, a challenge in itself. Yet, in some cases, people do come to a strong and stable viewpoint on the implementation or utilization of a complex technology (e.g., Kim, Chun, & Song, 2009; Poortinga, Aoyagi, & Pidgeon, 2013). It is therefore important to understand the psychological factors that either complicate or facilitate the achievement of cognitive closure on complex, technological topics.

The main goal of the current dissertation is to identify psychological factors that affect the ease with which people form a closed attitude about the implementation of a complex technology. In doing this, I specifically focus on aspects of this process that may be addressed in public communications about complex technologies. Increasing our understanding of such factors and the ways in which these may either inhibit or facilitate the achievement of closure is highly relevant for policy makers who try to inform the general public in the best possible way, as well as for those who aim to predict public opinion on the introduction of new complex technologies. Being aware of what stands in the way of people's ability to form a closed and definite opinion makes it possible to inform people in such a way that is most likely to be helpful to them in making up their mind. Thus, rather than examining how people can be persuaded to accept a novel technology, I am mainly interested in finding out how they come to the conclusion that they have adequate information to form their definite attitude. Hence, in my research I focus on factors that determine the extent to which people manage to achieve cognitive closure in their opinion, instead of examining the content, or valence of their resulting stance.

To achieve this goal, in the different empirical chapters I address a number of psychological factors that complicate or facilitate the achievement of cognitive closure about a complex technology. First, I examine whether and how potentially unsettling thoughts and feelings that arise in response to the implementation of a

complex technology—risk perceptions and negative emotions in particular—hinder the achievement of cognitive closure. Second, I empirically assess whether the perceived ability to achieve closure actually facilitates the process of making up one's mind when being asked to take a stance on a particular issue. Finally, I examine whether and how the ability to achieve closure is determined by characteristics of the information received, and how this impacts on people's impressions about the expertise of the source that will provide them with information that may help them form an opinion.

In this thesis I will focus on the complex technology of carbon capture and storage (CCS) as a relevant example of a complex, novel technology. CCS is a climate change mitigation technology that is considered important for stabilizing greenhouse gas concentrations in the atmosphere (IPCC, 2007). The technology involves the capture of CO_2 produced in power plants or other industrial sources, transportation of the CO_2 to underground storage sites (e.g., depleted oil and gas fields), and long-term storage in these sites. As is the case with other complex (energy-related) technologies, the public's opinion can be a decisive factor for the successful implementation of CCS (e.g., Markusson et al., 2011; Terwel et al., 2012). As such, CCS is an appropriate subject for the examination of the achievement of cognitive closure on the implementation of complex technologies. The next section will provide a theoretical background for the research conducted in this dissertation.

Attitude Content versus Attitude State

Much of the research on attitudes and attitude formation in the context of complex technologies so far has focused on the content of people's point of view (e.g., Cass & Walker, 2009; Dütschke, 2011). However, as indicated above, the significance of people's attitudes for the implementation of a complex technology is not only determined by *what* people think of the technology (i.e., the content, or positive vs. negative valence of their attitude), but also by the *state* of their attitude, that is; the degree to which this point of view is closed and fixed. Yet, little attention has been paid to factors that determine the extent to which people form a closed attitude about a complex technology. The central outcome I examine in this dissertation on attitude formation about complex technologies is hence the degree to which people feel they can, or actually do *achieve cognitive closure* on the complex technology of CCS, rather than examining the valence of these attitudes as being in favor of or against the introduction of CCS.

Unsettling Thoughts and Feelings in the Context of Complex Technologies

Most people are relatively unfamiliar with many of the technological innovations in modern society (e.g., De Best-Waldhober et al., 2009). Moreover, even if people are aware of a complex technology's existence, their general knowledge and understanding of the technology's many aspects (e.g., its functionality or application) is oftentimes limited or even non-existent. When people are informed of the possible implementation of such a relatively unknown and (to them) incomprehensible technology, for instance via a public information campaign, it is therefore no surprise that various unsettling thoughts and feelings tend to arise (e.g., Pidgeon, Harthorn, & Satterfield, 2011). For example, when hearing about political plans to store CO_2 underground in a nearby area, people may wonder how this might impact them or affect their daily lives. Moreover, they may be concerned about a variety of possible outcomes, for instance whether the technology will affect their physical health or wonder whether this might reduce the value of their property. I argue that such unsettling reactions to the potential implementation of a complex technology are likely to impact on the extent to which people manage to form a definite, closed attitude on the topic.

In this thesis I specifically focus on risk perceptions and negative emotional reactions; thoughts and feelings that people commonly experience in reaction to the (potential) implementation of a complex technology. I examine how these reactions are related to the achievement of cognitive closure on the topic. The influence of these unsettling reactions on the *valence* of people's attitudes has already been examined and demonstrated extensively in prior research (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978; Siegrist, 1999; Slovic, 1987, 2010). To extend existing insights, I propose that perceiving risks and experiencing negative emotions at the prospect of the implementation of a complex technology also affect the level of *cognitive closure* that people achieve in their attitudes on the technology. I examine this question in Chapter 2.

Risk perception

One of the main areas of concern regarding complex, technological innovations tends to be the technology's potential risks and hazards (e.g., Sharp, Jaccard, & Keith, 2009). At the same time, however, most people have difficulty finding out precisely what these are. Indeed, not only are lay people likely to over- or underestimate risks, but they also tend to have trouble understanding the meaning of a change in probability of risks (Johnson & Tversky, 1983; Loewenstein, Weber. Hsee, & Welch, 2001; Slovic, Finuncane, Peters, & MacGregor, 2004). In addition to being difficult to comprehend, the notion of risk essentially implies that outcomes are *uncertain*. When people are uncertain about

some issue, they are more likely to avoid choices or decisions about that particular issue altogether (Dhar & Simonson, 2003). To the extent that risk perceptions raise the salience of uncertain consequences, they may thus reduce the likelihood that people form a closed attitude on the implementation of a complex technology.

Perceived risks can pertain to a broad range of issues or concerns, from potential physical damage (public health hazards) to the question of whether the technology has been thoroughly tested (its anticipated effectiveness and safety). This implies, in turn, that people may consider a large variety of aspects of a complex technology when trying to determine its general risk (Fischhoff et al., 1978; Savadori et al., 2004; Singleton, Herzog, & Ansolabehere, 2009; Slovic, 1987, 1992). As such, merely examining people's overall impression of the level of risk associated with a particular technology can only provide limited insight into the relation between risk perception and the achievement of cognitive closure. Prior research has attempted to disentangle different aspects of risk perception by means of a psychometric approach. This revealed that it is possible to statistically discern different dimensions of risk perception (e.g., Fischhoff et al., 1978; Savadori et al., 2004). Thus, prior work has identified two main dimensions; one representing the extent to which the risks seem *novel and unknown* (i.e., lack of familiarity), and the other standing for the extent to which the risks' consequences are considered *catastrophic and dreadful* (i.e., catastrophic potential; Fife-Schaw & Rowe, 1996; Fischhoff et al., 1978; Slovic, 1987). Studies on the perceived risks of *distinct* technologies, as opposed to people's general notion of risk, have revealed further dimensions representing additional concerns, such as the degree to which people believe they will be personally exposed to the risks (e.g., Savadori et al., 2004; Sparks & Sheperd, 1994). In the present dissertation, in addition to overall risk perceptions, I thus assess *specific risks* perceived in relation to CCS with the purpose of investigating which dimensions of risk perception can be distinguished as relevant in the context of this complex technology. In doing this, I aim to understand which specific risk-related concerns help explain the level of cognitive closure that people achieve about the distinct technology of CCS.

Negative emotions

Learning about the possible implementation of a new and complex technology does not only bring to mind various risk-related concerns; it is also likely to evoke a range of negative *emotional* reactions, such as feelings of anger or fear (e.g., Cass & Walker, 2009; Huijts, Midden, & Meijnders, 2007; Lee, Scheufele, & Lewenstein, 2005). Previous research has demonstrated that distinct emotions can directly affect the judgments and decisions that people make in various ways (e.g., Lerner & Keltner, 2000,

2001; Loewenstein et al., 2001). I posit that the experience of certain emotions may also influence the extent to which people manage to achieve cognitive closure about the topic under concern. In the present thesis, I aim to discern different types of negative emotions that people can experience when they are informed of the implementation of CCS as a complex technology. I investigate whether and how distinct (clusters of) emotions in turn are associated with the extent to which people manage to achieve cognitive closure on the topic.

Indications of which emotions are likely to affect the level of closure that people achieve can be derived from the appraisal model of emotions. According to this model, there is no fixed connection between specific events and specific emotions raised. Instead, the emotions that people experience are thought to be determined by their interpretation—or appraisal—of the circumstances that elicit emotions (Moors, Ellsworth, Scherer, & Frijda, 2013; Smith & Ellsworth, 1985). For instance, the same event can elicit different emotions depending on whether the outcomes of the situation at hand are seen as either certain or uncertain. People may be angry about something that will certainly happen, such as the construction of a CO_2 storage site near their home. However, if the outcome of a particular event is considered to be *uncertain* (for instance when people question whether CO_2 might leak from underground storage sites), the primary emotion raised may be fear or tension—instead of anger. The appraisal model of emotions moreover accounts for the possibility that distinct emotions evoke the tendency to perceive new situations or events in line with the appraisal pattern associated with that particular emotion; an appraisal tendency (Lerner & Keltner, 2000, 2001). Thus, to the degree that people judge the implementation of complex technology as having uncertain results, they are more likely to experience emotions reflecting this uncertainty appraisal (e.g., fear or concern). As a consequence, their approach to the new situation is likely to be characterized by uncertainty as well. If the task at hand is to form an attitude about a novel technology, the experience of uncertainty thus is likely to prevent people from confidently deciding on a particular point of view (cf. Dhar & Simonson, 2003). This is why I anticipate that emotions evoked by uncertainty appraisals are likely to reduce the level of cognitive closure that people achieve.

The Ability to Achieve Closure

I argue that risk perception and the experience of negative emotions can make it more difficult for people to achieve cognitive closure on a complex technology. However, irrespective of the level of risk that people perceive or the negative emotions that they experience, forming an attitude about a complex technology is in itself already an intricate and challenging task. Indeed, media discussions on complex topics, such as

genetic modification of food, mainly indicate that members of the general public realize their ability to properly evaluate the situation is limited and find it difficult to take a stance. Notwithstanding their awareness that a genuine assessment of such complex topics is difficult if not impossible for non-experts, it is not uncommon for people to take a firm stance or make up their minds about a complex issue of which they know very little or have little understanding. This suggests that there are differences among people in the ease with which they achieve closure about a complex technology, and that they may rely on different cues to develop the feeling that they are able do to so. In the present thesis I therefore also examine the perceived ability to achieve closure, and different antecedents thereof, as potentially relevant factors in the actual achievement of cognitive closure.

The self-perceived ability to achieve closure has been recognized in the literature as a potential determinant of the extent to which people tend to decide on their point of view about a given topic (cf. Roets & Soetens, 2010; Roets & Van Hiel, 2007). Furthermore, recent research has demonstrated the relevance of the extent to which people feel capable of achieving closure for the manner in which they form judgments or make their decisions (Kossowska & Bar-Tal, 2013; Kossowska, Dragon, & Bukowski, 2014). I postulate that the perception that people have of their own ability to form a closed attitude also plays a significant role in the actual achievement of cognitive closure. In this context, I define the *ability to achieve closure* as the perceived ability to make judgments and decisions confidently and with certainty (cf. Roets & Van Hiel, 2007; Roets, Van Hiel, & Cornelis, 2006). Work by Kossowska and colleagues (2014) has provided initial evidence suggesting that people's ability to achieve closure can also be determined by external factors, instead of only representing stable individual differences. In Chapter 3 of this thesis I elaborate on this possibility. That is, I report research in which I have examined whether it is indeed possible to externally induce differences in the notion that people have of their own general ability to achieve closure. I further assess the extent to which communications that make people have confidence in their ability to achieve closure can also instigate actual differences in the level of cognitive closure that they achieve in their attitude formation regarding a complex technology.

Perceived source expertise and the ability to achieve closure

If the ability to achieve closure indeed determines the likelihood that people form a closed attitude about a particular topic or issue, in the context of complex technologies it is highly relevant to know which factors tend to affect this ability in daily life. Prior research on the impact of persuasive communication (for instance in product marketing) has shown that information is more convincing (i.e., it has a greater

impact on the content of people's attitudes) when originating from a source that is regarded as having high expertise, compared to low expertise (e.g., Cialdini & Goldstein, 2004; Pornpitakpan, 2004). Building on this prior work, I propose that people should feel better able to achieve cognitive closure about the implementation of a complex technology when they believe that they are consulting or receiving information from a *knowledgeable* source. I specifically examine whether and how the identity of a source and the message that is communicated influence such perceptions of source expertise. If these two factors affect people's impressions of an information source's relevant expertise, they should also impact on ability to achieve closure in this way. This question is addressed in Chapter 4.

When different individuals or stakeholders of a complex technology provide information, merely knowing who they are or which body they represent can function as an indicator of source expertise (e.g., Reimer, Mata, & Stoecklin, 2004). For instance, knowing whether a statement is made by a concerned citizen, a relevant professional, or a blogger already gives an idea of whether this source has relevant experience or is particularly knowledgeable about the topic in question. As such, the identity of an information source may determine people's perceptions of the source's expertise, and this perceived expertise in turn may affect people's ability to achieve closure.

In real life, a source of information on a complex topic is more likely to be comprised of a collection of individuals, or group of relevant stakeholders, such as citizens, or politicians, rather than of one specific individual. Moreover, in particular concerning complex topics, it is not necessarily the case that all individuals who together constitute a particular information source are in full agreement with each other. As a result, when such sources provide information about a complex technology, they do not always draw definite conclusions about the issue at stake. For instance, a government might report about its investigation of the possibility of drilling for shale gas ("fracking") in the country and communicate that not all of members of the government are convinced that this would be a safe and secure endeavor. The question is how a message of consensus, compared to non-consensus, colors the perceived expertise of the source in question, and thereby also affects the ability to achieve closure, among those receiving such information. I argue that an information source that expresses consensus about a complex topic will increase perceptions of expertise by evoking the impression that individuals draw on a common and objective knowledge base and that they "know what they are talking about". On the other hand, communicating disagreement about relevant concerns or conclusions might more easily be interpreted as a sign of diminished expertise, since this lack of consensus can, for instance, signal an inability of the source members to differentiate between more important and less important facts.

Communication of consensus (vs. non-consensus) may thus influence perceptions of source expertise and, as a result, impact on people's ability to form a closed attitude.

Overview of Studies and Empirical Findings Reported in This Thesis

Risk Perception, Negative Emotions, and the Achievement of Cognitive Closure

Chapter 2 focuses on different aspects of risk perception and specific negative emotions as impediments to the achievement of cognitive closure. By building on the psychometric approach to risk perception and the appraisal model of emotions I aimed to gain insight into which *specific* risk-related concerns and specific negative emotions, respectively, are related to the level of closure that people achieve on the implementation of a complex technology. A laboratory study assessed risk perceptions and negative emotional reactions among individuals after they learned about the implementation of carbon capture and storage technology (CCS). These responses were then related to the level of cognitive closure that people achieved when trying to determine their attitude on the implementation of the complex technology. The study revealed three different dimensions underlying people's risk perception of CCS (1. *catastrophic potential*, 2. *lack of control*, and 3. *lack of familiarity*) and two different clusters of negative emotions that people experience in response to CCS (1. *negative outcome certainty-related emotions* and 2. *negative outcome uncertainty-related emotions*). Results showed that the level of cognitive closure that people achieved on the implementation of CCS in the first place depended on the extent to which they saw the complex technology as risky in terms of potentially catastrophic consequences and in the second place on the extent to which they regarded the technology's risks as novel and unfamiliar. Thus, while lack of control represented a separate cluster of concerns in people's risk perceptions, this did not relate to their achievement of cognitive closure. In addition, the degree to which people experienced negative emotions that are associated with *uncertainty* (e.g., fear and concern) also reliably predicted the level of cognitive closure that people achieved. These results thus shed light on *why* people may have trouble forming a closed attitude when they perceive high risks or experience high levels of negative emotion. The particular aspects of risk perception and type of negative emotions that turned out to predict the formation of closed attitudes have in common that they indicate a sense of uncertainty or insecurity. To the extent that this uncertainty carries over to people's attitude formation, it causes them to feel incapable of confidently deciding on their definite point

of view. As such, the extent to which people feel *able* to achieve closure seems to indicate the mechanism underlying the effect of risk perception and negative emotions on the achievement of cognitive closure.

An additional aim of this study was to explore whether different communication strategies might have an impact on risk perceptions and negative emotions raised. Specifically, I examined whether risk perceptions and negative emotions might be mitigated by drawing parallels between the novel, complex technology in question and other, more familiar technologies. I compared whether the provision of so-called analogies in communication on CCS, or variations in the component of CCS that the communication addressed (CO_2 transport vs. CO_2 storage) might affect the level of risk that people attributed to the technology, the extent to which they experienced negative emotions, or the level of cognitive closure that they achieved. Results indicated that neither the use of analogies nor the CCS-component considered were of substantial influence on any of these dependent variables.

The Ability to Achieve Closure

Chapter 3 more explicitly addresses the notion that the (felt) ability to achieve closure may be an important antecedent of the actual achievement of closure in the context of complex technologies. Two studies were designed to examine whether experimentally induced differences in the degree to which people feel able of achieving cognitive closure indeed affects the level of closure that they subsequently reach in their attitude formation on a complex technology. These studies additionally investigated the further implications of forming a "closed" versus a more "open" attitude by examining how the achievement of closure impacted on people's openness to additional information on the complex technology in question which was made available to them at a later stage.

Study 3.1 tested whether people who were led to believe that they have a high (vs. moderate) ability to achieve closure actually achieved more cognitive closure in their attitude formation. Additionally, I examined whether and how the level of cognitive closure that people achieved was related to their willingness to consider and take into account additional attitude-relevant information. I expected that the ability to achieve closure would indirectly influence openness to additional attitude-relevant information through cognitive closure achieved.

To examine these predictions, I developed an experimental procedure to induce differences in people's perception of their own general ability to achieve closure on complex topics. This procedure provided research participants with bogus feedback from a test that ostensibly assessed their judgment and decision making habits regarding

complex topics. They subsequently received information about the specific complex topic of CCS and were requested to form an attitude towards the topic. Results confirmed the hypotheses by demonstrating that experimentally induced differences in the extent to which people perceived themselves as able of achieving closure affected the level of cognitive closure that they actually reached in their attitude formation. Additionally, I established that this had important consequences for their openness to additional information on the topic in question. That is, people achieved more cognitive closure in their attitudes on CCS both in their self-reports and in their willingness to take a stance in a poll when their perceived ability to achieve closure was induced to be high (rather than moderate). The achievement of cognitive closure in turn was found to reduce people's subsequent willingness to read and take into account additional information that might be relevant to their opinion (i.e., information on CCS).

Study 3.2 was a follow-up to Study 3.1 and designed to examine the robustness of these findings. An additional aim of this study was to investigate the boundary conditions of the extent to which cognitive closure achieved made people less open to additional attitude-relevant information. Specifically, in this study I compared people's willingness to consider information that is opinionative in nature to their openness to more factual information. The design and results of this study were largely similar to those of Study 3.1. Again, the extent to which people were led to see themselves as capable of making up their mind positively affected the level of cognitive closure that they achieved—at least in terms of their self-reported cognitive closure. Additionally, I was able to specify the further consequences of the level of cognitive closure that people achieved for their openness to subsequent information. By distinguishing between different types of information provided, I was able to ascertain that increasing the ability to achieve closure indirectly made people less inclined to read and consider additional attitude-relevant information, but apparently only when this information was opinionative in nature. Their openness to additional *factual* information did not appear to suffer when the ability to achieve closure was enhanced.

Perceptions of Source Expertise and the Ability to Achieve Closure

In the final empirical chapter I investigated how communicating about the characteristics of a source of information can impact on people's ability to achieve closure. The central argument developed in this chapter is that people experience a greater ability to achieve cognitive closure when they believe that they are receiving information from a source with high relevant expertise, compared to low expertise. I hypothesized that both the identity of an information source and the nature of the

communication—namely whether or not this source communicated consensus or non-consensus—were likely to affect perceptions of source expertise. To the extent that perceptions of source expertise were affected by such communications, this should then also influence people's ability to achieve closure.

Study 4.1 addressed the effect of source identity by examining how explicitly indicating the source of the information provided might affect the ability to achieve closure through its implications for perceptions of source expertise. In this study, people first read basic information on the complex technology of CCS and learned that they would soon receive additional information on the topic. I then manipulated the identity of the source of this additional information by explaining that this information was provided either by the "Association of Citizens and Sustainability" or the "Association of Dutch Geophysicists and Sustainability". As predicted, level of expertise that was ascribed to the information depended on the source's identity; people considered the Geophysicists to have higher relevant expertise than the Citizens Association. Importantly, I established that higher perceived expertise of the information source in turn increased people's ability to achieve closure.

Study 4.2 followed up on this finding and additionally examined whether the communication of consensus (vs. non-consensus) might also influence perceptions of source expertise and hence impact on the achievement of closure. The design of the study orthogonally manipulated the identity of the information source (Citizens Association vs. Geophysicists) and the communication of consensus vs. non-consensus within this source. Otherwise, the procedure of the study was similar to the procedure of Study 4.1. In addition to learning about the identity of the information source, people thus also read that members of this information source either agreed or disagreed among themselves, before the level of perceived expertise and their ability to achieve closure were assessed. Subsequently, and in extension of the previous study, people actually received information on CCS that supposedly originated from the information source and in which consensus or non-consensus was expressed. Next, I assessed the level of cognitive closure that they achieved. Results again provided evidence in line of my reasoning that the identity of the source impacts on perceived source expertise, and in this way influences the ability to achieve closure. In addition, this study revealed that people regard an information source to have more expertise, and therefore feel better able to achieve closure, when the source communicates consensus rather than non-consensus. The added value of communicating consensus primarily emerged when high expertise of the information source could not clearly be inferred from its identity.

Discussion and Conclusions

The implementation of most modern day complex technological innovations cannot succeed without acceptance of these technologies by the public (e.g., Dütschke, 2011; Markusson et al., 2011; Read et al., 2013; Terwel et al., 2012). Although people are generally willing to declare their attitude towards the utilization of a complex technology, these attitudes are often "open" and therefore hardly predictive of actual support for or opposition against the technology in question (e.g., De Best-Waldhober et al., 2009). Attitudes about which people have achieved a state of cognitive closure (i.e., closed attitudes) are on the other hand more predictive of support and opposition than open attitudes (cf. Krosnick & Petty, 1995; Petty & Cacioppo, 1986b). Hence, it is important to know and understand which factors relate to the achievement of cognitive closure in the context of complex technologies. In this thesis I demonstrate how certain psychological factors complicate or facilitate the achievement of closure about complex technologies, and how these can be induced by communicating to the public in a particular way. As such, the research in this thesis has both important theoretical and practical implications.

As mentioned above, most previous research on the achievement of cognitive closure has focused on the role of people's need for closure (e.g., Kruglanski, 1989, 1990; Kruglanski & Webster, 1991, 1996; Webster & Kruglanski, 1994, 1997). The findings of the present dissertation indicate that in addition to differences amongst individuals in their need for closure, the achievement of closure also depends on their *ability* to achieve closure, that is; how difficult or easy people find it to form a closed attitude in a particular situation. Specifically, I established that people feel less able to achieve closure to the extent that they perceive more risks and experience more negative emotions at the prospect of a complex technology being implemented. I was also able to determine which aspects of risk perception and which types of emotions are most likely to have this effect, hence clarifying that those who communicate to the general public should pay particular attention to the *uncertainties* associated with complex, novel technologies, and to how to reduce these uncertainties.

I also established that—regardless of the information that is being provided—people take the perceived expertise of the source providing information as a cue to determine their ability to achieve closure. Specifically, results of my research revealed that attributing high relevant expertise to an information source that provides information on the topic in question actually facilitates the achievement of closure on the basis of this information. Moreover, I demonstrated that the conviction that a particular source has relevant expertise not only depends on its identity, but is also

affected by the extent to which communications emphasize the presence versus absence of consensus within this source.

Thus, I was able to establish different factors that are relevant to the notion that people can feel more or less capable of achieving closure. Such feelings are important because I found that people who feel well able to form a closed attitude in fact do achieve more cognitive closure than those who are led to believe that they are not as capable. That is, they are more ready to take a stance in an opinion poll and less likely to read or consider additional opinionative information that becomes available to them at a later stage. These findings together demonstrate that particularly in the domain of complex technologies, people's *ability* to achieve closure is an important antecedent of the achievement of closure and that this explains differences in closure achieved above and beyond individual differences in people's *need* for closure.

Theoretical Implications

The results of the research reported in this thesis resonate with prior work on the concept of ambivalence; the co-existence of positive and negative evaluations of an attitude object. For instance, the relation found in Chapter 2 between the achievement of closure and feelings of uncertainty somewhat resembles the (conditional) association between ambivalence and uncertainty (e.g., Van Harreveld, Rutjens, Rotteveel, Nordgren, & Van der Pligt, 2009). Moreover, one could argue that people who have both positive and negative evaluations of an attitude object, and are hence ambivalent, would have more difficulty to deciding on their attitude than those who hold a more univalent attitude. Although it is indeed likely that there is a (negative) relation between the psychological state of ambivalence and the ability to achieve cognitive closure, it is important to note that these two concepts differ from each other. Indeed, they should also have an independent effect on the achievement of cognitive closure. The present research offers several observations supporting this notion. First, the study in Chapter 2 shows that while perceiving CCS as risky in terms of catastrophic potential may lead people to have a more negative attitude on the technology, it also reduces the chance that they achieve closure on this attitude. This indicates that people who have trouble achieving closure are not necessarily ambivalent on the topic in question, but can also have a strong (univalent) point of view. Moreover, ambivalence only evokes feeling of uncertainty when people are pressed to decide on their attitude, while these feelings are not experienced when such a forced choice is absent (Van Harreveld et al., 2009). Hence, while people who feel ambivalent may have trouble achieving closure when they are obliged to "take a side", they may well form a closed attitude when retaining a more ambivalent perspective is acceptable. Thus, although it is very probable that the state

of ambivalence and the ability to achieve closure are related, the two concepts do not appear to be mutually interchangeable.

The concepts and findings discussed in the present dissertation appear to resemble certain ideas and concepts from the elaboration likelihood model (ELM: Petty & Cacioppo, 1986). For one, the ELM and the present research both examine the ways in which people try to make up their mind about the topic at hand. The ELM, however, primarily concentrates on the evaluation of persuasive arguments and the consequences for the valence of an attitude, while the focus of this dissertation is on the state of the attitude formed, regardless of its valence. Another apparent resemblance is that, similar to cognitive closure, attitude strength used in the ELM pertains to an attitude's durability and impactfulness (Krosnick & Petty, 1995; Kruglanski & Webster, 1996; Kruglanski, Webster, & Klem). Yet, whereas attitude strength is considered a characteristic that can only be deduced from an attitude's durability and impactfulness, cognitive closure is considered a distinct psychological construct that consists of a subjective experience with important consequences for attitude durability and impactfulness. Furthermore, both ELM and the present research adhere to the notion that the level of cognitive closure or the degree of strength that people reach in their attitude is in part determined by their ability to do so. Importantly, within the ELM, this ability is an *objective* ability to scrutinize relevant arguments that is determined by the individual's cognitive capacity and relevant knowledge available (Petty & Cacioppo, 1986). In the ELM framework, a high ability allows for processing relevant arguments via the central processing route, which involves critical evaluation of such information. Such high effort elaboration on arguments will then lead to a relatively strong, well-informed attitude. By contrast, the ability to achieve closure is a *subjective* ability based on people's *perceptions* of their capacity to come to a definite conclusion and take a stance (cf. Kossowska & Bar-Tal, 2013). Moreover, unlike in the ELM, the route from this ability to the formation of a solid attitude (i.e., the achievement of cognitive closure) does not necessarily involve high-level, critical evaluation of information (Kossowska et al., 2014). Most importantly, the present research thus that people's ability to form a solid attitude (i.e., a strong attitude or cognitive closure) can be based on subjective experiences, instead of objective competencies. This idea is in line with recent research that has highlighted the importance of perception and subjective experience for people's cognitive capabilities (e.g., Clarkson, Hirt, Jia, & Alexander, 2010).

Practical Implications

The view of the general public on a complex technology is of great interest to those involved in the implementation of many such technologies. However, the public opinion

and the way it unfolds can also often be a puzzling phenomenon to these stakeholders. For instance, people may take a strong stance while knowing very little about a complex technology in question. On the other hand, people can remain undecided in situations where a lot of information is available and experts or stakeholders believe that there are really very few reasons to cast doubt on the implementation of a technology. The findings from this thesis elucidate additional moderating factors that might play a role here, and hence help to understand these paradoxical observations. For instance, when people receive information from a non-expert source containing a an unambiguous (consensual) message, this may cause them to feel quite comfortable deciding on their point of view, even when they have little knowledge of the topic in question. Conversely, when people somehow consider a technology to be risky, they are less likely to be decided on their point of view on the implementation of the technology. In fact, feelings of uncertainty and the negative emotions may dominate their responses, making them less inclined to take a stance, even if relevant information from expert sources is available to them. Situations similar as the ones I examined in this dissertation are quite likely to occur in real life, for instance, when lay people overestimate risks or their notion of risk is not in line with the views of experts on the topic (cf. Johnson & Tversky, 1983; Savadori et al., 2004).

The findings presented in this dissertation do not only add to our understanding of public opinion formation on complex technologies. In addition, the experimental procedures followed to examine the achievement of cognitive closure about a complex technology may be informative to stakeholders and policy makers who communicate about (the implementation of) such a technology. Specifically, they demonstrate concrete communication strategies that can help create circumstances under which people will feel most able to achieve the cognitive closure that is needed for declared opinions to be predictive of their actual positions. A first conclusion is that people tend to rely more on a source with higher perceived expertise when trying to form a closed attitude on complex topic on which they themselves are no experts. The identity of an information source is one element of communication on which people base their impression of source expertise. It would hence be advisable to make salient the identity of the source when providing information from experts to the public. For those who provide information on complex topics for the public interest, it is furthermore important to be aware of the impact that the content of the message can have on perceptions of source expertise. Since agreement among members of an information source is regarded a sign of high expertise, it would make sense to communicate about this consensus when possible. In situations where such agreement is not or cannot be reached, it appears to be even more pressing to be explicit about the professional qualifications of information

source's members. That is, the results from Chapter 4 seem to suggest that the negative effects of communicating a lack of consensus on people's perceptions of source expertise and their ability to achieve closure are likely to be less pronounced when people are made aware of the expert identity of the source.

Moreover, in order to help people determine their point of view, it appears to be important to tailor communications on complex technologies to specific concerns that the general public is likely to have. The findings from Chapter 2 show that particular types of concerns are likely to stand in the way of the achievement of closure, namely perceiving a technology as risky in terms of potential catastrophic consequences and unfamiliarity of the risks, and experiencing uncertainty about the general consequences of implementing the complex technology in question. Leaving these concerns unaddressed and unsettled will most likely reduce the usefulness of communication on a complex technology for making up one's mind. Therefore, if the state of affairs allows for it, presenting the technology as having low risk and providing undisputed (i.e., certain) information on the technology's consequences should increase the chance that people establish their point of view. In sum, the results of the present research clarify that those who communicate about complex technologies should not only attend to factors that influence what people think of a technology. In addition, whilst designing such communications one should also consider the effects that information provided has on the likelihood that people feel confident and competent in making up their minds—regardless of what they decide.

Limitations and Future Directions

The achievement of cognitive closure is generally seen as consisting of a "seizing" component, where the formation of an attitude is closed off, and a "freezing" component, where the attitude that is acquired is stabilized and held on to (Kruglanski & Webster, 1996). Both the self-report measure and the behavioral measure of cognitive closure achieved that were employed for the research in this thesis predominantly addressed the "seizing" component of achieving closure. Although a number of items of the self-report measure did address the freezing, or crystallization, of people's attitudes, the current studies did not directly address the distinction between these two components, nor did they assess whether people actually held on to their acquired attitudes over time. As such, the present results do not provide direct evidence that the effects found on the achievement of closure also extend to the crystallization of attitudes. Notwithstanding this limitation of the present research, it is important to note that there is a strong (theoretical) positive link between the seizing and the freezing components of achieving closure (cf. Kruglanski & Webster, 1996; Roets & Van Hiel, 2007). Hence, there is good

reason to believe that people who initially achieved higher levels of closure as indicated by the present measures were also more likely to hold on to their attitudes. Further, the present work does offer some evidence suggesting that people are actually less likely to be interested in and consider additional information that becomes available to them, once they have achieved closure. Arguably, this could be interpreted as an indication that they are in the process of "freezing" the attitude they have formed. Nevertheless, future research might more explicitly distinguish between these two components of achieving cognitive closure.

The results from this dissertation on the self-report measure of cognitive closure show that participants often only managed to achieve a moderate level of cognitive closure on the topic under consideration (CCS), that is; somewhat under or just above the midpoint of the scale. The finding that most participants did not reach high levels of cognitive closure on the very complex and relatively novel technology of CCS should not come as a complete surprise. After all, not only is CCS a topic difficult to comprehend, participants also received only basic information on the topic, making attitude formation about the technology even more challenging. Moreover, participants formed a point of view on CCS because they were *asked* to do so, rather than personally motivated by, for instance, personal interest in the topic. It is important to note that although participants generally only managed to reach an intermediate level of closure at most, this still had important consequences for the degree to which they were open to additional opinionative information and for the likelihood that they would commit to their attitude and take a stance in a poll. The fact that even this modest range of cognitive closure achieved had significant consequences suggests that the conclusions drawn in this dissertation might actually be understated with regard to the implications of achieving cognitive closure. That is, when people do achieve high levels of cognitive closure, this may make them even more inclined to commit to their attitude and potentially leave them completely closed off to additional opinionative input. Such a situation might arise when people have both a high ability to achieve closure and a high need (i.e., motivation) for closure. This emphasizes the importance of additional investigations of the interaction between the ability to achieve closure and the need for closure (cf. Kossowska & Bar-Tal, 2013).

The fact that the research in this dissertation has been carried out with samples primarily consisting of Dutch undergraduate students might raise questions regarding the broader generalizability of these findings. On the one hand, university students, such as the participants in the present studies, may be more used to dealing with complex and nuanced information and topics. As a result, they may generally be more confident in their attitude formation compared to members of the general public. On the other

hand, however, one may also argue that the homogeneity of the participant samples that were used is likely to suppress the variance observed, and hence offers a conservative test of the relations examined. Thus, there is no *a priori* reason to argue for or against the broader applicability of the observed results for other samples or populations. Future research is hence required to establish more specifically whether and how the conclusions that can be drawn from the effects observed in this thesis might be limited by the specific characteristics of our current study samples.

The studies in this dissertation aim to examine how people form their attitude about complex, novel technologies. In all cases, the technology under consideration was related to carbon capture and storage (CCS). Nevertheless, there is no reason to assume that the observations made are limited to this specific technology. Indeed, in principle, similar effects should be likely to occur in the context of other technologies or topics with similar levels of complexity that give rise to risk-related concerns, questions about the outcome of the situation, or of which people have limited knowledge and understanding. Contemporary examples of such issues are future applications of nanotechnology—a field that is currently still in development—or large scale public policy changes, such as the reform of a national health care insurance system (e.g., "Obamacare"). Arguably, similar issues relating to risk perceptions, uncertainty-related emotions, the perceived (in-)ability to form a definite opinion, and concerns about the expertise of different information sources are likely to play a role here, and should be taken into account when communicating about these issues with the aim of enabling the general public to form their opinion.

Because this research was the first to address the ability to achieve closure as a construct of central theoretical and practical relevance, I focused on demonstrating the nature of this construct, and set out to identify aspects of public communications that might relate to this ability. Now that different factors that play a role in this context have been uncovered and their separate and independent effects have been established, future research may further look into the ways they might interact with each other. That is, when combining the factors that were examined in different chapters of this thesis, it may be possible to uncover moderating effects or boundary conditions of effects established here. For instance, a question of interest might be whether the positive effect of perceived source expertise on the ability to achieve closure is still observed when people believe the technology in question to be very risky or feel very concerned and fearful about its implementation. Moreover, on the one hand, research in this dissertation suggests that when lack of familiarity is one of the main aspects of perceived risks, information revealing that the risks associated with the technology are in fact common and familiar should facilitate the ability to achieve closure. On the

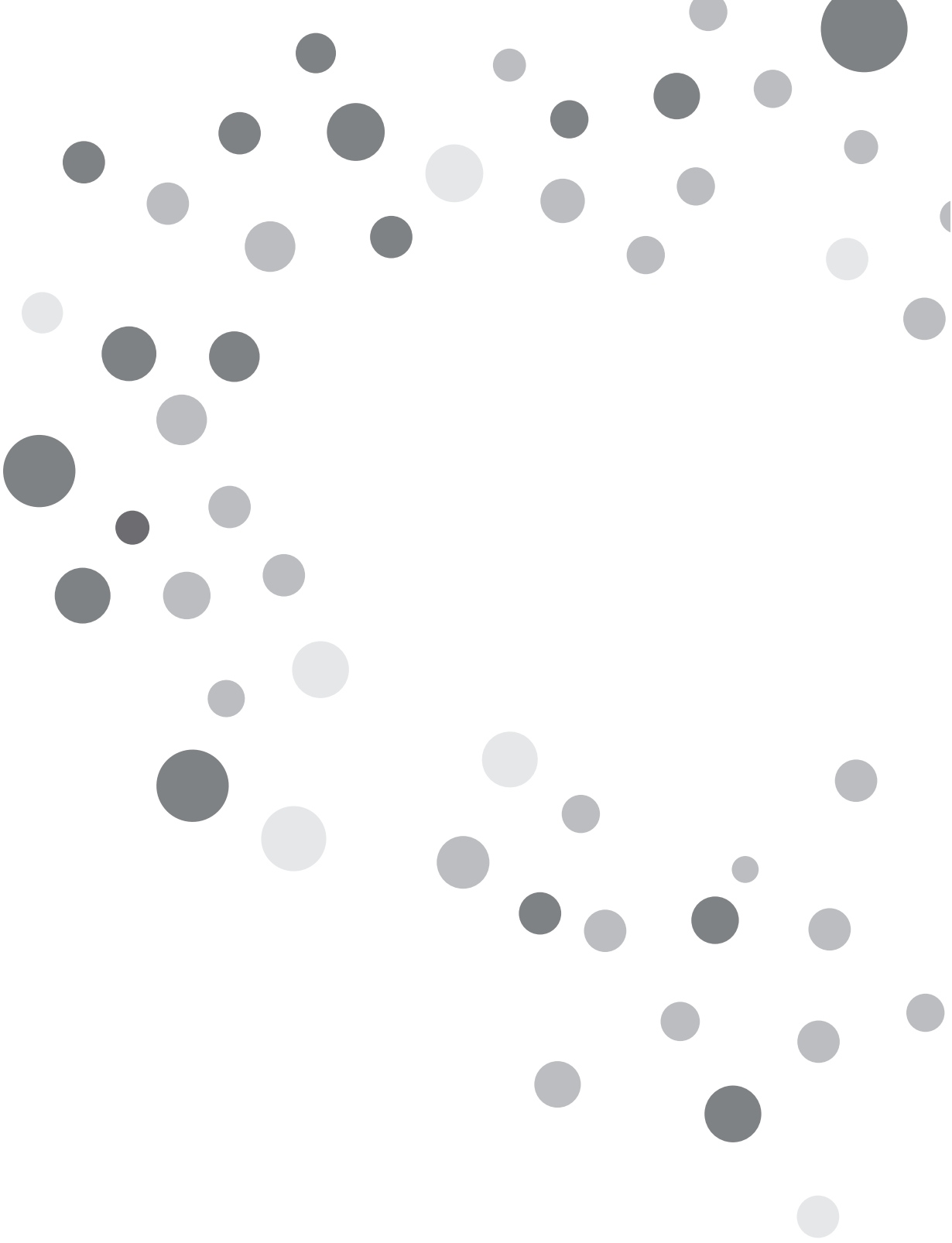
other hand, however, the effectiveness of such information is likely to depend on the identity of the source providing such information. That is, information that helps people understand that the risks involved in the complex technology are actually quite limited, is more likely to contribute to their ability to achieve closure when it originates from knowledgeable stakeholders. Nevertheless, since information communicating low risk can be seen as being in the interest of stakeholders aiming to implement the technology, people may believe this information to be persuasive in nature. Hence, even if they do not question the relevant expertise of the source, the nature of the information provided may cause them to call into question its trustworthiness or motives. Previous research has shown that lack of such integrity-based trust may lead to psychological reactance (De Vries, 2014; Terwel, Harinck, Ellemers, & Daamen, 2009). In sum, now that it has been established how important such communication aspects can be, it is relevant to further address their more complex and interactive effects in future research, to assess how these affect people's ability to achieve closure.

Conclusion

The research presented in this dissertation demonstrates that those who aim to predict public support for a complex, novel technology cannot simply rely on standard opinion polls. In addition it is relevant to assess people's ability to achieve *cognitive closure*, as a way to anticipate whether such stated opinions will actually be predictive of future behavior. The extent to which people feel able to form an attitude about a complex technology affects the level of cognitive closure they actually achieve. This ability to achieve cognitive closure depends on the perceived risks and negative emotions associated with the technology, on characteristics of the information source that communicates about the technology, and on the message that is communicated by this source. Despite individual differences in people's *need* to achieve closure (that have been examined in prior research), the *ability* to achieve closure can be induced by external circumstances. The ability to achieve closure is also independent of the valence of people's attitude as being for or against the technology in question. It predicts the likelihood that people actually take a stance on the issue under consideration, and indirectly impacts on their willingness to receive and consider additional information that becomes available. As such, these results provide novel insight into the mechanisms underlying the achievement of cognitive closure, as well as aspects of public communication that can help people achieve closure.

Preceding note on Chapters 2–4

The individual chapters that follow are each written with the intent to submit for publication as separate journal articles. They can therefore be read separately and in any order. This also implies that readers will notice some overlap between the different chapters. The studies reported in the empirical chapters were carried out in the context of a joint research project, and these texts have been prepared in close collaboration with my supervisors. As a result, they have been written in the first person plural ("we" rather than "I").



Chapter 2

How Risk Perception and Negative Emotions Relate to the Achievement of Cognitive Closure on Complex Technologies

This chapter is based on Koot, C., Ter Mors, E., & Ellemers, N. (2014). *How risk perception and negative emotions relate to the achievement of cognitive closure on complex technologies*. Manuscript in preparation.

Complex technological innovations form a central part of today's society and new innovations are presented to the world almost on a daily basis. Think for example of technologies aimed at reducing CO_2 emissions, such as carbon capture and storage (CCS), or recent developments regarding the production of synthetic (in vitro) meat. Implementation of such technologies generally cannot succeed without acceptance or support by the public (e.g., Dütschke, 2011; Markusson et al., 2011; Read et al., 2013; Terwel et al., 2012). Anticipating this, those involved in the implementation of a complex technology commonly attempt to gain insight into people's points of view by means of, for instance, opinion polls or interviews. People are generally quite willing to declare their "attitude" towards the utilization of a complex technology, also when their knowledge of the topic is low—or even non-existent—and the formation of their attitude has not yet been completed (De Best-Waldhober et al., 2009; also see Bishop et al., 1980; Scheufele & Lewenstein, 2005). However, such pseudo-attitudes, or open attitudes, are very unstable and therefore not a proper reflection of whether people will support or oppose the technology in question (e.g., De Best-Waldhober et al., 2009). Closed attitudes—attitudes about which people have achieved a state of cognitive closure—are on the other hand known to be more stable and more predictive of actual behavior than open attitudes (cf. Bassili, 1996; Fazio & Zanna, 1978; Krosnick & Petty, 1995; Petty & Cacioppo, 1986b). Closed attitudes are hence more useful for predicting support for versus opposition to the issue at stake. Thus, to understand public opinion regarding the implementation of complex or novel technologies, and the unfolding thereof, it is of high interest to know which factors relate to the achievement of cognitive closure.

When people are prompted to think about the implementation of a complex technology, for instance by information they receive from the technology's stakeholders or when talking to others about the topic, various thoughts and feelings may arise (e.g., Pidgeon et al., 2011). People may find themselves wondering about the effects that the technology will have on their lives, or be upset about the amount of money that a government is willing to invest in a new technology. Such reactions to the potential implementation of a complex technology may in turn affect the extent to which people manage to form a definite, closed attitude on the topic—irrespective of whether they feel inclined to accept or object to the proposed technology. In the present research, we will specifically assess risk perceptions and negative emotional reactions—thoughts and feelings that people commonly experience in reaction to the potential implementation of a complex technology—to examine how these reactions are related to *the achievement of cognitive closure* on the topic. We will focus on the complex technology of carbon capture and storage (CCS); a climate change mitigation technology that is considered important for stabilizing greenhouse gas concentrations in the atmosphere (IPCC,

2007). The technology involves the capture of CO_2 produced in power plants or other industrial sources, transportation of the CO_2 to underground storage sites (e.g., depleted oil and gas fields) and long-term storage in these sites. As is the case with other complex (energy-related) technologies, the public's opinion can be a decisive factor for the successful implementation of CCS (e.g., Markusson et al., 2011; Terwel et al., 2012).

Risk Perception

When informing the public about the plan to implement a novel, complex technology, such as nanotechnology or CCS, stakeholders and proponents of the technology will generally highlight the benefits and utility of the proposed innovation. Concerns of the general public, on the other hand, tend to focus more on the risks that are potentially involved with the technology (e.g., Sharp et al., 2009). At the same time, people often have difficulty accurately grasping concepts of risk and chance. That is, they do not fully understand the implications of a change in probability and are likely to over- or underestimate risks (Johnson & Tversky, 1983; Loewenstein et al., 2001; Slovic et al., 2004). In addition to being difficult to comprehend, the notion of risk entails a level of uncertainty. When people experience uncertainty about a decision, they are more likely to "opt out" and avoid making up their minds all together (Dhar & Simonson, 2003). As such, perceiving risks may only further complicate and obstruct the formation of a closed attitude regarding an issue that in itself is already intricate and challenging to begin with. We hence anticipate that perceiving a complex technology as risky will lower the chance that people form a closed, definite attitude—in other words, that they achieve cognitive closure—about the technology.

Anticipating that people have skewed or inflated views of a technology's risks, stakeholders tend to provide correct information about the technology's risks and safety to the public. By making such efforts to redress inflated risk perceptions they may facilitate the formation of (closed) attitudes on the technology. Perceived risks, however, can pertain to a wide of issues or concerns, which implies that people may consider many different aspects of a complex technology when trying to determine its overall risk (Fischhoff et al., 1978; Savadori et al., 2004; Singleton et al., 2009; Slovic, 1987, 1992). They may, for instance, be preoccupied with the physical harm (i.e., health risks) that a technology could induce. Alternatively, people may doubt the extent to which experts and stakeholders have actually assessed and taken into account risks that are relevant to the general public (e.g., loss of property value) instead of focusing on risks associated with the business case alone (e.g., return on industrial investment). Prior work has attempted to disentangle different aspects of lay risk perception from a psychometric point of view. This approach has revealed that it is possible to statistically distinguish

between different dimensions of risk perception (e.g., Fischhoff et al., 1978; Savadori et al., 2004). However, this prior work has not compared aspects of risk perception in terms of their *relevance* for the achievement of cognitive closure. Our current aim therefore is to establish whether and how specific dimensions of risk perception relate to the level of cognitive closure that people achieve in their attitudes. Going beyond the assessment of overall risk perceptions allows us to shed more light on which risk-related concerns are particularly relevant in this context, and thus should be addressed in communications about a complex technology in order to facilitate the achievement of cognitive closure. In the present research, in addition to assessing overall risk perception, we will therefore also examine specific risks perceived in relation to CCS. Our main aim in doing this is to examine which dimensions of risk perception can be discerned in this context, and to investigate whether these help understand the level of cognitive closure that people achieve about CCS.

Prior research has revealed that a distinction can generally be made between two dimensions of risk perception. These represent the extent to which the risks seem *novel and unknown* on the one hand (i.e., lack of familiarity), and the extent to which their consequences are considered *catastrophic and dreadful* (i.e., catastrophic potential) on the other hand (Fife-Schaw & Rowe, 1996; Fischhoff et al, 1978; Slovic, 1987; Tokushige, Akimoto, & Tomoda, 2007a). We anticipate these two main aspects of risk perception to emerge in the present research as well. Additionally, some studies on the perceived risks of distinct technologies have revealed further dimensions, which represent, for instance, the degree to which people believe they will be personally exposed to the risks or the usefulness of the proposed innovation (e.g., Savadori et al., 2004; Sparks & Shepherd, 1994). Because we aim to examine risk perceptions specifically relating to the introduction of CCS (rather than assessing more general notions of risk associated with technological developments in society), we anticipate that in addition to the two primary dimensions of risk perception (lack of familiarity and catastrophic potential) we may also find additional relevant concerns associated with people's risk perception of CCS.

It seems likely that people are hesitant to close off their attitude formation when they believe that many of the risks involved with a complex technology are yet unfamiliar to them or to stakeholders involved with the technology. Perceptions of high risk in terms of a lack of familiarity with these risks may thus form a hindrance to the achievement of cognitive closure. On the other hand, risk perception in terms of the catastrophic potential that people attribute to a complex technology may also form a significant impediment to the achievement of cognitive closure. While the level of catastrophic damage that a technology may cause hits close to home, the chance of such damage occurring is generally speaking very low. Trying to anticipate the implications of

a very small likelihood of occurrence in combination with severe consequences should be very difficult for the average person, and may therefore result in inertia regarding the achievement of cognitive closure, that is; hamper the formation of a closed attitude.

Negative Emotional Reactions

The prospect of a new and complex technology being implemented does not only bring to mind various risk-related concerns; it is also likely to evoke a range of negative *emotional* reactions (e.g., Cass & Walker, 2009; Huijts et al., 2007; Lee et al., 2005). Different emotions may, for instance, arise because people have moral objections to a technology (e.g., anger or outrage about "tampering with nature"), because they perceive the political decision making procedures surrounding the implementation of the technology to be unfair (e.g., frustration; cf. Krehbiel & Cropanzano, 2000), or because they are unsure of the impact that a technology may have on their daily lives (e.g., worry).

Previous research has demonstrated that emotion states can directly impact on people's judgment and decision making in various ways (e.g., Lerner & Keltner 2000, 2001; Loewenstein et al., 2001). For example, trait anxiety has been negatively associated with decisiveness (Kimes & Troth, 1974), and research by Lerner and Keltner (2000, 2001) has revealed that distinct emotions can steer people's judgments of new situations or events. This suggests that the experience of certain emotions may also influence the extent to which people manage to achieve cognitive closure about the topic of concern. In the present research, we therefore aim to distinguish between different types of negative emotions that people can experience when they are invited to think about the implementation of CCS. Subsequently, we will investigate whether and how separate (clusters of) emotions are associated with the extent to which people form a closed attitude regarding the implementation of this technology.

The concern that public opposition can be a significant obstacle to the implementation of complex technologies has prompted prior research on emotions in this context to focus on how affective responses predict people's (negative) attitudes towards novel technologies. As a result, much attention has been paid to emotions that are most salient and directly visible in the context of public opposition or protest to a technology (such as anger or disappointment; e.g., Cass & Walker, 2009; Jasper, 1998). Other relevant emotions, such as concern or tension, tend to be more private in the sense that these are less likely to result in overt, behavioral expressions. As a consequence, the significance of such emotions for attitude formation about complex technologies like CCS may be easily overlooked by both researchers and stakeholders. Yet, this type of emotions would seem particularly relevant to the understanding of the

achievement of cognitive closure.

Indications of which emotions are likely to be of influence on the level of closure that people achieve can be found in the appraisal model of emotions. This model posits that there is no fixed connection between specific events and specific emotions raised. Instead, the emotions that people experience are thought to be determined by their interpretation, or appraisal, of the circumstances that elicit emotions (Moors et al., 2013; Smith & Ellsworth, 1985). For example, depending on whom we hold responsible for breaking a window (ourselves or another person), we may either feel guilty (ourselves) or angry (another person). Likewise, the same prospect or event can give rise to different emotions depending on whether we appraise the outcomes of the situation at hand as being either certain or uncertain. Thus, people may be angry about something that will certainly happen, such as the construction of a power plant or CO_2 storage site near their home. However, to the extent that the outcome of a particular event is regarded uncertain, the primary emotion raised may be tension—instead of anger. Such a situation is likely to occur when people do not know the extent to which a proposed course of action may be disadvantageous to them, for example in terms of health hazards due to the introduction of nuclear energy.

The appraisal model of emotions additionally accounts for the possibility of a mutually reinforcing relationship between emotions experienced and further situational appraisals. Research by Lerner and Keltner (2000, 2001) revealed that distinct emotions evoke the tendency to see new situations or events in line with the appraisal pattern of that particular emotion; an appraisal tendency. Thus, to the extent that people evaluate the implementation of complex technology as having uncertain outcomes, they will experience emotions reflecting this uncertainty appraisal (e.g., fear or concern), and, as a consequence, their approach to the new situation is likely to be characterized by uncertainty as well. If the task at hand is to form an attitude about a novel technology, the experience of uncertainty is hence likely to prevent people from confidently deciding on a particular point of view (cf. Dhar & Simonson, 2003). In sum, based on the appraisal model of emotions and prior research we anticipate the experience of emotions that are relating to or indicative of uncertainty appraisals to be particularly likely to reduce the level of cognitive closure that people achieve.

Communication About CCS: the Use of Analogies

Examining the relation between risk perception, negative emotions, and the achievement of cognitive closure may provide insights that can be used to design communication about CCS and other complex technologies. Specifically, such communications may be tailored to affect people's risk perception and emotions to the

extent that they are enabled to achieve closure on the topic. A common way to provide information about unknown or novel technologies is to point out how these resemble more familiar and existing technologies; providing people with an analogy. This strategy is also used by stakeholders involved in the introduction of complex technologies. In theory, the provision of an analogy may be an effective way to guide people's risk perception and emotional reactions. Pointing out how the complex, relatively unfamiliar technology resembles a technology or phenomenon that is already known might reduce the perceived catastrophic potential or lack of familiarity and could curb uncertainty and tension arising from the novel technology. As a result, explicit references to more familiar analogues when communicating about complex technologies could facilitate the formation of a closed attitude about the novel technology. Indeed, research by Tokushige, Akimoto, and Tomoda (2007b) and Itaoka and colleagues (2012) suggests that the use of a (natural) analogue of CCS may impact people's risk perception and attitudes towards the technology. Importantly, however, it is as yet unknown what this implies for our current research question, that is, whether the use of analogies may also affect the achievement of *cognitive closure*. Thus, in addition to examining the relation between risk perception, negative emotions, and the achievement of cognitive closure, the present research also explores the possibility that the provision of an analogy affects the level of cognitive closure that people achieve.

Study 2

The primary goal of present research was to examine the correlates of cognitive closure. That is, we assessed whether the risks that people perceive and the negative emotions they experience when they are prompted to think about a complex technology—in this case carbon capture and storage (CCS)—lower the likelihood that they form a closed, definite attitude about the technology. Additionally, we explored whether risk perception, negative emotions, and level of cognitive closure achieved depend on the specific CCS component that is addressed (i.e., CO_2 transport or CO_2 storage), or on the way in which it is introduced (with or without drawing an analogy). The data for this research were collected in two waves with virtually identical research designs and measures. In the first wave ($N = 97$) we counterbalanced whether participants were prompted to think about CO_2 transport or about CO_2 storage, and we systematically varied whether or not a comparison with an analogous technology (natural gas transport and natural gas storage, respectively) was drawn. The second wave of data collection ($N = 122$) only addressed CO_2 storage and systematically varied whether or not a comparison with the analogous technology of natural gas storage

was drawn. After learning about CO_2 transport or CO_2 storage (and in the analogy conditions after being informed about an analogous technology), participants completed a questionnaire containing the dependent variables. The wording of items in the questionnaire was adapted to refer to the specific CCS-component under consideration (CO_2 transport or CO_2 storage), but was otherwise identical. Results of both data collection waves revealed no systematic effects of analogy use or CCS-component on the dependent variables[1]. Therefore, we decided to aggregate the data collected in these two waves for the analysis of the relations between risk perception, negative emotions, and level of cognitive closure achieved, which was the main focus of the present research, as this larger sample size increased statistical power of the analyses presented.

Participants

Two hundred nineteen students (57 men and 162 women; M_{age} = 20.14, SD = 2.82) participated in the study (when the two waves of data collection were combined) and received a monetary reward or course credit in return.

Procedure

Both data collection waves were administered as the first study in a set of unrelated studies. Upon arrival at the laboratory, participants were led to individual cubicles, each containing a PC on which the experiment would be conducted. They learned that the study concerned a method of reducing CO_2 emissions in the atmosphere; carbon capture and storage technology (CCS). Participants then read a brief introductory text on CCS—largely based on the text previously used by Ter Mors, Weenig, Ellemers, and Daamen (2010)—which discussed the relation between CO_2 emissions and climate change, and contained a description of the three main components of CCS: CO_2 capture, transport, and storage. Next, participants read that across the entire country inhabitants of the Netherlands might have to deal with CCS, as CO_2 can be *transported via pipelines/ stored underground* (the content of the text depended on the CCS-component that was addressed) in many locations in the country. Therefore—so it was explained to participants—the current study examined people's views on the implementation and safety of *CO_2 transport via pipelines/CO_2 storage in depleted natural gas fields*. Next, a text followed which contained additional information about the CCS-component in question (either CO_2 transport or CO_2 storage). At this point, some participants also received information drawing the comparison with an analogous technology of *CO_2 transport/ CO_2 storage* (natural gas transport/natural gas storage, respectively). After reading these texts on CCS, participants declared their initial attitude on *CO_2 transport via pipelines/*

1 The specific design, stimulus materials, and results of each of the two waves can be found in Appendix.

CO_2 storage in depleted natural gas fields by indicating to what extent they thought the implementation of the technology in the Netherlands to be a good idea (1 = a very bad idea, 7 = a very good idea). Participants next completed the measures of overall risk perception, cognitive closure achieved, negative emotions, and specific risk perceptions. Finally, we also included a standard questionnaire assessing individual differences in need for closure as a control measure. At the end of the series of studies in which the participants took part they were debriefed and thanked for their participation.

Measures

Overall risk perception

Participants' general inclination to perceive the technology under consideration (either CO_2 transport via pipelines or CO_2 storage in depleted natural gas fields) as risky or safe was measured with two items. Participants indicated on a 7-point scale to what extent they thought the respective CCS-component was safe (1 = *very unsafe*, 7 = *very safe,* reverse-coded) and to what extent they thought it was risky (1 = *not at all risky*, 7 = *very risky*). An overall risk perception scale was calculated by averaging participants' responses to these two items (α = .81), so that higher scores indicate higher levels of overall perceived risk of the respective CCS-component.

Cognitive closure achieved

We measured the level of cognitive closure that participants achieved in their attitude on the respective CCS-component by means of a 13-item questionnaire. These items were largely extrapolated from previously existing scales that asses psychological factors and processes leading up to a relatively definite decision or judgment; the original decisiveness subscale of the original Need For Closure Scale (Webster & Kruglanski, 1994) and the Ability to Achieve Cognitive Structure scale (Bar-Tal, 1994). Participants were thus asked to indicate their agreement with 13 statements such as "I am certain of my opinion on the implementation of *CO_2 transport/CO_2 storage* in the Netherlands", "I feel undecided about my opinion on the implementation of *CO_2 transport/CO_2 storage* in the Netherlands" (reverse-coded), and "My opinion on the implementation of *CO_2 transport/CO_2 storage* in the Netherlands is fixed" (ranging from 1 = *completely disagree*, to 7 = *completely agree*). A cognitive closure scale was calculated by averaging participants' responses to the items (α = .88) on which higher scores indicate higher levels of cognitive closure achieved.

Negative emotions

Participants were asked to rate the extent to which they experienced specific negative emotions "when thinking about the implementation of *CO_2 transport via*

pipelines/CO_2 storage in depleted natural gas fields in the Netherlands", on a scale from 1 (*does not apply at all*) to 7 (*applies very much*). The list presented to participants contained emotions that are "traditionally" examined in the context of complex technologies, such as anger, as well as emotions that are less frequently assessed and relate to uncertainty, such as discomfort. In total, the list contained the following ten items: concern, disappointment, sadness, discomfort, tension, fear, anger, rage, hopelessness, and disgust.[2]

Specific risk perceptions

Participants' specific risk perceptions associated with the proposed technology (CCS) were assessed by means of 16 items (7-point Likert scales). Similar to previous research on the psychometric properties of lay risk perception, these items addressed catastrophic potential of and lack of familiarity with the technology's risks (e.g., Savadori et al., 2004; Tokushige et al., 2007b), and also tapped into, among other things, perceived controllability of the risks. The items as used in the present study are presented in Table 2.1.

Table 2.1.

Specific Risk Perception Items of CO_2 Transport via Pipelines/CO_2 Storage in Depleted Natural Gas Fields

	Item	Response labels
1.	To what extent do you think that risks of *CO_2 transport/CO_2 storage* are known to science?	1 = very unknown 7 = very well known
2.	To what extent do you think that risks of *CO_2 transport/CO_2 storage* are new risks?	1 = not at all new 7 = very new
3.	How familiar are you yourself with risks of *CO_2 transport/ CO_2 storage*?	1 = not at all familiar 7 = very familiar
4.	Do you think that potential negative effects of *CO_2 transport/CO_2 storage* will occur in short term or long term?	1 = very short term 7 = very long term
5.	Do you think that very few or very many people will be exposed to risks of *CO_2 transport/CO_2 storage* with the implementation of *CO_2 transport via pipelines/CO_2 storage in depleted natural gas fields*?	1 = very few people 7 = very many people

2 To prevent that the negative emotion questionnaire would evoke an overall negative mind set, we first asked participants about the experience of two positive emotions; hope and enthusiasm. Principal component analysis (varimax rotation) on all 12 emotion items revealed that these two positive emotions together formed a separate cluster, distinct from the negative emotions measured ($\alpha = .70$). This positive emotion cluster was not significantly related to the level of cognitive closure that participants achieved (Pearson's $r = -.01$, $p = .909$).

6.	To what extent do you think that people know that they are exposed to risks of *CO_2 transport/CO_2 storage*?	1 = they do not know at all 7 = they know very well
7.	To what extent do you think that you personally will run risk when *CO_2 transport via pipelines/CO_2 storage in depleted natural gas fields* is implemented in the Netherlands?	1 = no personal risk at all 7 = a very large personal risk
8.	To what extent do you think that exposure to risks of *CO_2 transport/CO_2 storage* is divided inequitably among people?	1 = divided very inequitably 7 = divided very equitably
9.	To what extent do you think that exposure to risks of *CO_2 transport/CO_2 storage* is a voluntary choice for people?	1 = not at all voluntary 7 = completely voluntary
10.	To what extent do you think that risks of *CO_2 transport via pipelines/CO_2 storage in depleted natural gas fields* can be controlled by people?	1 = not at all controllable 7 = very controllable
11.	To what extent do you think that risks of CO_2 transport via pipelines/CO_2 storage in depleted natural gas fields can be easily reduced?	1 = not at all 7 = very much
12	To what extent do you think that possible damage caused by *CO_2 transport via pipelines/CO_2 storage in depleted natural gas fields* can be perceived by people?	1 = not at all perceptible 7 = very well perceptible
13.	To what extent do you think that CO_2 transport via pipelines/CO_2 storage in depleted natural gas fields poses risks for future generations?	1 = no risks at all 7 = very large risks
14.	To what extent does the idea of CO_2 transport via pipelines/CO_2 storage in depleted natural gas fields scare you?	1 = not at all 7 = very much
15.	To what extent do you think that risks of *CO_2 transport via pipelines/CO_2 storage in depleted natural gas fields* can have catastrophic consequences?	1 = not at all catastrophic 7 = very catastrophic
16.	To what extent do you think that risks of *CO_2 transport via pipelines/CO_2 storage in depleted natural gas fields* can have deadly consequences?	1 = no deadly consequences at all 7 = certainly deadly consequences

Need for closure

Prior research on cognitive closure has shown that individuals with a higher need for closure may also achieve higher levels of cognitive closure (e.g., Webster & Kruglanski, 1994). To rule out the possibility that relations between risk perception, negative emotions, and cognitive closure achieved might be accounted for by individual differences in participants' need for closure, this factor was measured as control variable. We assessed individual differences in participants' need for closure by means of the 15-

item need for closure scale developed by Roets and Van Hiel (2011) (α = .82). Higher scores on the 7-point scale indicate that the individual in question overall has a higher need for closure. The measure was presented as a separate study in the data collection session.

Results

Factor Analysis

Dimensions of risk perception

We set out to examine whether we might distinguish between different dimensions of risk perception. To this end, we performed a principal component analysis with varimax rotation on participants' responses to the 16 specific risk perception items. An initial analysis revealed a five-factor structure in which the first three factors, comprising 12 out of 16 items, were clearly interpretable and statistically consistent. The remaining four items (items no. 1, 4, 8, and 9 in Table 2.1) did not clearly relate to any of these three main factors, nor did they form reliable additional factors. We therefore excluded these items from our final analysis.

A principal component analysis with varimax rotation on the 12 risk perception items that were retained yielded three factors together explaining 54.1% of the variance in the individual items. To reflect the content of the items included in each of these factors we interpreted the three factors as the following dimensions of risk perception: 1. *catastrophic potential,* 2. *lack of control,* and 3. *lack of familiarity*. Catastrophic potential represents participants' concerns regarding the catastrophic implications that the risks involved with CCS may have in terms of the extremity and magnitude of anticipated consequences. Lack of control captures the extent to which people suspect that risks involved with CCS cannot be observed, reduced, or controlled. Lack of familiarity indicates the extent to which people believe the risks of CCS to be novel as well as their personal lack of familiarity with these risks. For each dimension a composite score was computed by averaging participants' ratings on the highest loading items, as indicated in Table 2.2, so that higher scores indicate higher risk perception (for mean scores, see Table 2.4).

Table 2.2.

Factor Analysis of Scores on Specific Risk Perception Items: Rotated Factor Loadings.

Item number	Factor 1 (catastrophic potential)	Factor 2 (lack of control)	Factor 3 (lack of familiarity)
15.	0.854		
16.	0.833		
7.	0.751		
14.	0.679		
5.	0.676		
13.	0.528		
11. (rc)		0.783	
12. (rc)		0.644	
10. (rc)		0.553	
6. (rc)			0.782
3. (rc)			0.729
2.			−0.410
Cronbach's alpha	.84	.47	.43

Note: Principal component analysis with varimax rotation. Items marked with "rc" are reverse coded. Only factor loadings above 0.400 are displayed.

Negative emotion clusters

We also examined whether we might distinguish between different clusters of negative emotional reactions to the (potential) implementation of CCS in the Netherlands. A principal component analysis on the 10 negative emotion items revealed a two-factor solution explaining 68.1% of the variance in the individual items. The factor loadings of the specific emotions after varimax rotation are presented in Table 2.3. This two-factor division of negative emotions matches a theoretical distinction proposed by the appraisal model of emotions (see also Moors et al., 2013). That is, the first cluster (Factor 1) represents (negative) emotions in response to certain outcomes (e.g., anger), whereas the negative emotions items with high loadings on the second cluster (Factor 2) all relate to outcome *un*certainty (e.g., fear). Henceforth we will refer to the two negative emotion clusters as representing: 1. *outcome certainty-related emotions* (rage, anger, sadness, disappointment, disgust, and hopelessness[3]), and 2. *outcome uncertainty-related emotions* (fear, concern, tension, and discomfort). For each cluster, a composite score was computed by averaging participants' ratings on the highest loading items, as

3 Even though the emotion "hopelessness" revealed equally high loadings on the first and second factor (0.542 and 0.529, respectively), we included it in the first cluster for theoretical reasons. Inclusion of hopelessness in the second cluster did not change the pattern of results.

indicated in Table 2.3, so that higher scores indicate higher (negative) emotion intensity (for mean scores, see Table 2.4).

Table 2.3

Factor Analysis of Scores on Negative Emotion Items: Rotated Factor Loadings.

Emotion	Factor 1 (outcome certainty-related)	Factor 2 (outcome uncertainty-related)
Anger	**0.869**	
Rage	**0.865**	
Sadness	**0.782**	
Disappointment	**0.774**	
Disgust	**0.759**	
Hopelessness	**0.542**	0.529
Fear		**0.835**
Tension		**0.806**
Concern		**0.766**
Discomfort		**0.726**
Cronbach's alpha	.89	.83

Note: Principal component analysis with varimax rotation. Item loadings in boldface indicate the items that were used to compute the index of the corresponding factor. Only factor loadings above 0.400 are displayed.

Table 2.4.

Mean Scores, Standard Deviations, and Bivariate Correlations between Cognitive Closure Achieved, General Risk Perception, Risk Perception Dimensions, and Emotion Clusters.

	M	SD	1	2	3	4	5	6
Cognitive closure achieved	3.63	1.00						
General risk perception	3.94	1.16	−.40***					
Risk perception dimensions								
1: catastrophic potential	4.16	1.03	−.47***	.54***				
2: lack of control	4.19	0.96	−.14*	.35***	.29***			
3: lack of familiarity	5.18	0.91	−.39***	.17*	.31***	.22**		
Emotion clusters								
1: outcome certainty-related	2.16	1.12	−.25***	.32***	.37***	.13	.11	
2: outcome uncertainty-related	3.64	1.29	−.42***	.48***	.54***	.18**	.18**	.58***

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

Attitude Valence

The present research did not focus on the valence of participants' viewpoints on the complex technology in question (CCS). However, attitude valence has been the focus of many previous studies in the context of complex technologies. We therefore conducted a stepwise multiple regression analysis to check whether and how any of the risk perception dimensions and negative emotion clusters might relate to participants' (positive or negative) attitudes towards the implementation of CCS. As might have been anticipated, this analysis revealed that participants were more likely to report a negative attitude towards the implementation of CCS to the extent that they reported more negative outcome certainty related emotions ($\beta = -.34$, $t = -5.14$, $p < .001$), and perceived CCS to have more catastrophic potential ($\beta = -.18$, $t = -2.75$, $p = .006$). Participants' attitudes towards CCS were, however, not significantly predicted by the risk perception dimensions lack of control and lack of familiarity, or by negative outcome uncertainty-related emotions.

Furthermore, we checked whether the measure of cognitive closure achieved was related to the measure of attitude valence by computing the correlation between the measures. Pearson correlation revealed that there was no significant relation between these two measures (Pearson's $r = .09$, $p = .184$), suggesting that the measure of cognitive

closure achieved gauged a component of people's attitudes that is different from attitude valence.

Relations with Cognitive Closure Achieved

Correlations

We first computed bivariate Pearson correlations for an initial examination of the relations between overall risk perception, the three risk perception dimensions (catastrophic potential, lack of control, and lack of familiarity), the two negative emotion clusters (outcome certainty-related emotions and outcome uncertainty-related emotions), and participants' level of cognitive closure achieved on the implementation of CCS (see Table 2.4). Participants' overall risk perception concerning CCS correlated moderately and negatively with cognitive closure achieved, indicating that the more participants perceived CCS as a risky technology overall, the less they achieved cognitive closure on the topic. The correlations between the specific risk perception dimensions and cognitive closure achieved revealed similar relations; all three dimensions were negatively, albeit not equally strongly, related to the achievement of cognitive closure. The experience of outcome certainty-related emotions and outcome uncertainty-related emotions also correlated negatively with the formation of a closed attitude; this relation was somewhat stronger for outcome uncertainty-related emotions.

Multiple regression analysis

A number of the specific dimensions of risk perception and clusters of negative emotions revealed significant intercorrelations. This makes it difficult to infer the separate and unique relations between each risk perception dimension and each cluster of negative emotions on the one hand, and the achievement of cognitive closure on the other from these statistics. We therefore conducted a stepwise multiple regression analysis to examine more specifically how each risk perception dimension and each negative emotion cluster relates to the level of cognitive closure that participants achieved on the implementation of CCS. In this analysis the three risk perception dimensions (catastrophic potential, lack of control, and lack of familiarity) and the two negative emotion clusters (outcome certainty-related and outcome uncertainty-related emotions) served as predictor variables and cognitive closure achieved served as dependent variable. The final model explained 32.2% of the variance ($F[3, 215] = 34.19$, $p < .001$), and contained three significant predictors of cognitive closure achieved. Level of cognitive closure achieved was most clearly predicted by catastrophic potential ($\beta = -.26$, $t = -3.74$, $p < .001$); lack of familiarity followed as the second predictor ($\beta = -.27$, $t = -4.55$, $p < .001$), and outcome uncertainty-related emotions emerged as the

third and final significant predictor of cognitive closure achieved ($\beta = -.23$, $t = -3.48$, $p < .001$). Thus, the more participants thought that the implementation of CCS would be risky in terms of catastrophic potential, the more they perceived the risks involved with CCS to be novel and unfamiliar, and the more they experienced outcome uncertainty-related emotions (e.g., fear and concern), the less they managed to achieve cognitive closure in their attitude on the technology. After inclusion of these three predictors, no additional variance in level of cognitive closure achieved could be explained by lack of control or outcome certainty-related emotions (βs $\leq .04$, ts ≤ 0.64, ps $\geq .526$).

We ran an additional analysis to rule out the possibility that the effects found on achievement of cognitive closure could be explained by individual differences in participants' need for closure. For this purpose, we conducted a stepwise multiple regression analysis on cognitive closure achieved with the risk perception dimensions and negative emotions clusters as independent variables, while controlling for differences among participants in their overall need for closure. Individual differences in need for closure did not emerge as a significant predictor ($\beta = -.07$, $t = -1.14$, $p = .256$) in this analysis, nor did the inclusion of this additional predictor alter the outcomes of the main analysis in which two risk perception dimensions and one negative emotions cluster significantly predicted cognitive closure achieved.

Discussion

The present research assessed risk perception and negative emotional reactions among individuals who were prompted to think about the implementation of a complex technology (carbon capture and storage technology, or CCS). Both risk perception and negative emotions were related to the level of cognitive closure that participants achieved in their attitude on the implementation of the technology. By distinguishing between different dimensions of risk perception and different clusters of negative emotions, we were able to uncover which concerns and emotions are most likely to stand in the way of achieving cognitive closure. That is, our results revealed that the level of cognitive closure that participants achieved on CCS in the first place depended on the extent to which they considered the complex technology risky in terms of catastrophic potential and in the second place on the extent to which they regarded the technology's risks as novel and unfamiliar. In addition, the extent to which people experienced negative emotions that are evoked by outcome uncertainty (e.g., fear and concern) also reliably predicted the level of cognitive closure that participants achieved in their attitudes on CCS. We furthermore discerned a third dimension of risk perception (lack of control) as well as another cluster of negative emotions experienced in response to the implementation

of CCS (outcome certainty-related emotions). However, neither of these two factors predicted the achievement of cognitive closure.

The current research additionally explored whether the use of analogies in communication about the complex technology of CCS, or the specific component of CCS that was under consideration (CO_2 storage or CO_2 transport) affected the level of risk that people perceived, the extent to which they experienced negative emotions, or the level of cognitive closure that they achieved. Results revealed that neither the analogies that we provided nor the specific CCS-components we considered impacted substantially on the dependent variables examined here.

Theoretical Implications

Most of the research that has so far examined the achievement of cognitive closure has focused on the importance of individual differences in people's need for closure (e.g., Kruglanski, 1990; Kruglanski & Webster, 1996; Webster & Kruglanski, 1994, 1997). The present research adds to the literature by demonstrating the existence of two previously unexamined antecedents of the achievement of cognitive closure, namely perceived risk in terms of catastrophic potential and lack of familiarity, and the experience of negative outcome uncertainty-related emotions.

Importantly, we discerned different dimensions of risk perception and clusters of negative emotions, which allowed us to go beyond the *general* impact of risk perception or emotional responses on the achievement of cognitive closure. As such, the present results help to understand which *specific* concerns in risk perception and which negative emotions stand in the way of forming a closed attitude. Prior efforts to understand the antecedents of opposition to or public protest against the implementation of novel technologies have primarily addressed the origins of negative attitudes and anger about proposed changes. Our current attempt to understand differences in people's ability to achieve cognitive closure has allowed us to uncover that *uncertainty* about likely risks and outcomes (due to novelty and possibly catastrophic outcomes) has an important impact on the extent to which people manage to form a closed attitude. Thus, when people express reluctance to accept a novel technology this does not necessarily indicate that a negative opinion has been formed. Instead, it may just as well reflect the fact that they feel so uncertain about the likely outcomes of proposed changes, and about how this might affect them, that they feel unable to make up their mind. This finding extends existing insights on attitude formation and has important practical implications.

With respect to negative emotional reactions, it turns out that negative affect is particularly likely to impede the achievement of cognitive closure when the emotions raised cause people to approach the new situation or task—forming an attitude about

a complex technology—with *uncertainty*. The specific emotions that can incite such a state of mind are those which arise when people are unsure of the outcome that the present situation—the implementation of a complex technology—will have (e.g., fear and tension; Lerner & Keltner, 2000, 2001). This further validates our analysis of the achievement of closure on complex technologies in terms of uncertainty about likely outcomes. Moreover, it extends prior findings on the relevance of emotional reactions for attitude formation in the context of complex technologies which to this date has primarily focused on emotions that are associated with public resistance and protest, namely anger and outrage.

Thus, the more nuanced insight that the present research provides into the relations between risk perception, negative emotions, and achievement of cognitive closure also sheds light on *why* people may have trouble forming a closed attitude when they perceive high risks or experience high levels of negative emotion. The notion that people can differ in the extent to which they feel able to achieve closure has been recognized in previous literature and has been supported by recent research (Kossowska et al., 2014; Roets & Soetens, 2010; Roets & Van Hiel, 2007). The present data extend these prior observations by examining which aspects of risk perception and which specific emotions relate to such differences in people's ability to achieve closure. The particular aspects of risk perception and type negative emotions that emerged as predictors of the formation of closed attitudes share a common denominator of uncertainty or insecurity. Thus, the present data allow us to conclude that if for some reason people experience uncertainty at the prospect of a complex technology being implemented, this uncertainty may carry over to their attitude formation and cause them to feel incapable of confidently deciding on their definite point of view.

In the domain of attitude formation, a lot of attention has been paid to factors that impact on the *valence* of people's attitudes (e.g., Cialdini & Goldstein, 2004; Pornpitakpan, 2004). In addition to valence, the state of an attitude (i.e., the level of cognitive closure achieved) has also been shown to be an important component of attitude formation, as it determines the stability or volatility of the attitude (cf. Bassili, 1996; Fazio & Zanna, 1978; Krosnick & Petty, 1995; Petty & Cacioppo, 1986b). The present research demonstrates that the content, or valence, of an attitude and the level of closure achieved on the attitude state are two independent factors. This implies that the mere fact that something impacts on what people think about a certain topic, does not necessarily mean that this point of view will also be solidified as a consequence, or vice versa: the extent to which people feel able to form a definite opinion in itself does not indicate the likelihood that they will be in favor or against the issue under consideration. Indeed, our findings reveal that determinants of the achievement of cognitive closure

can diverge from the factors that influence attitude valence. For instance, perceiving a technology as having potentially disastrous consequences will cause people to view the technology more negatively, but simultaneously decreases the chance that they will achieve cognitive closure on this (negative) point of view. When examining factors that impact on people's attitude formation, it is thus important to attend to influences on attitude valence as well as on the achievement of cognitive closure.

With regard to the complex technology of carbon capture and storage (CCS), the present research is, to our knowledge, the first to empirically distinguish between specific risk perceptions of CCS and relate these to the extent to which people manage to make up their minds about the technology (i.e., achieve cognitive closure). In line with various prior studies on risk perception, our results revealed two main dimensions of risk perception relevant for the perceived risk of CCS: a lack of familiarity of the risks and the catastrophic potential of the risks (e.g., Fischhoff et al., 1978). Furthermore, resonating with prior studies on risk perception of distinct technologies or other specific topics (e.g., Savadori et al., 2004; Sparks & Shepherd, 1994), the present results revealed an additional aspect relevant to the perceived risks of CCS. In the present research, this third dimension represents a perceived lack of *control* over the technology's risks. This aspect of risk perception has also been taken into account in prior studies, but tended to be seen as indicating lack of familiarity (Fischhoff et al, 1978; Slovic, 1987). Our results revealed that lack of control can be seen as a separate dimension of risk perception, and in this way underline the subtle, but important, differences between people's general conceptions of risk and the perceived risks of a specific technology.

Practical Implications

The potential risks of a novel and complex technology often form a major public concern and can raise opposition to its implementation. Stakeholders of such technologies would therefore do well to gain a better understanding of people's risk-related concerns. The risk perceptions and negative emotions that people experience in response to a complex technology are often approached as indicators of negative attitudes or oppositional behavior to such technologies (e.g., Siegrist, 1999). At times, they are even regarded as irrational thoughts and feelings that are in need of management (cf., Cass & Walker, 2009). The present results demonstrate, however, that this might not be a fruitful approach. It might be more helpful to consider the possibility that certain aspects of risk perception and types of emotions represent potentially valid worries and concerns, and to be aware that these can hinder the achievement of cognitive closure. Hence, it is advisable for stakeholders of complex technologies to go beyond seeing perceived risks and negative emotions as a source of trouble among

the general public. That is, when risk perceptions indicate concern with catastrophic potential and risk familiarity, and negative emotions indicate impressions of outcome uncertainty, this can signal *indecision* about the technology in question in addition to predicting future resistance against it. Such reactions may therefore be regarded as relevant pieces of information in their own right, primarily indicating that people may still feel *insufficiently informed* about the potential consequences of proposed changes to be able to make up their mind. If this is the case, stakeholders would do well to further investigate the nature of people's worries and concerns to be able to address these more effectively in public communications.

To some extent stakeholders of the implementation of a complex technology (e.g., a governmental body) seem to realize that this is the case, and often do provide information about the technology to the public in order to help people form an opinion and determine their point of view. Nevertheless, it is usually less obvious what specific concerns people have, or whether these are actually targeted by the information provided. The present research indicates that it is important to first examine relevant impediments to people's ability to achieve closure to be able to tailor subsequent communications to the specific concerns that the general public is likely to have. Communications that fail to do this (i.e., address people's concerns in communication) can in fact evoke reactions that actually hinder the formation of a definite, closed attitude. Our results provide pointers for designing such effective communication about complex technologies. Regarding risk-related concerns, best practice would be to communicate about stakeholders' awareness of the different potential risks and about how the risks of the technology for each of the different stakeholders involved have been assessed. Likewise, it would seem important to be very explicit about the specific nature of such risks and the potential consequences of an accident or problem with the technology. Furthermore, it appears advisable to inform people of established, certain facts as much as possible, as a way to limit the emergence of emotions associated with outcome uncertainty.

At this point, we emphasize that the current research is not intended to provide policy makers or professional communicators with tools to manipulate or deceive the general public, for instance by downplaying possible risks associated with the introduction of such novel technologies. In fact, we think our results suggest that such an approach in communication about a complex technology is likely to backfire to a point where it raises suspicion about the extent to which relevant risks have actually been identified, or evokes uncertainty about additional concerns that are not communicated. We do propose, however, that adjustment of inflated risk perceptions via communication of relevant facts may help people make up their mind about what they actually think of

the technology in question. Arguably, enabling people to determine what they actually think—even if this makes them conclude they are against the proposed innovation—is always preferable to the situation where they are expected to make up their mind without having the information required to be able to do so. Indeed, pressing people to take a stance while they feel unable to achieve cognitive closure is likely to result either in (unfounded) resistance, or in the expression of a pseudo-attitude that is not predictive of future responses. Likewise, our aim to better understand the achievement of cognitive closure should not be seen as implying that achieving maximum closure always is the most desired state. To the extent that valid and correct information is available, people can benefit from this information to form a clear and definite attitude. However, achievement of cognitive closure seems less desirable when the information available is insufficient, one-sided, or of low quality. Hence, while we think it is highly relevant to distinguish between declared opinions or positional statements that reflect high versus low cognitive closure (among others things because of their differential value in predicting future behavior), we do not suggest that the achievement of cognitive closure is a desired end state in its own right.

Limitations and Future Directions

The present research aimed to assess whether the risks that people perceive and the negative emotions they experience when they are informed of complex technology reduce the likelihood that they form a closed attitude about the technology. By discerning different dimensions of risk perception and different clusters of negative emotions, we were able to reveal which aspects of risk perception and negative emotions uniquely relate to the achievement of cognitive closure. The main goal of this research was to distinguish between specific dimensions of risk perception and clusters of emotions and to examine how these relate to the achievement of cognitive closure. We therefore did not attempt to directly manipulate the extent to which participants would experience particular thoughts or emotions. As a consequence, the setup we chose for this study does not allow us to draw definite conclusions about causal relations between risk perceptions and emotions on the one hand and the achievement of cognitive closure on the other. Now that we have established which factors are of interest and how these relate to each other, a relevant follow-up question is to examine whether and how these might be influenced with specific manipulations. This would be an interesting avenue for future research.

From an applied perspective it might be relevant to examine whether differences in risk perception and emotional reactions, which consequently lead to differences in cognitive closure, can be induced by communication on the topic in question. The

present results on analogy use in communications about a complex technology remind us that such effects may not be easily achieved. Designing such tailored communication would hence require careful investigation of relevant factors and elaborate pre-testing to ensure its desired effects.

We have argued above that the negative effect of outcome uncertainty-related emotions on the level of cognitive closure achieved can be understood from the appraisal model of emotions. The negative emotions that people experience when they appraise the current circumstances as having uncertain outcomes (e.g., tension and concern) evoke a tendency to see new tasks or situations (i.e., forming an attitude about a complex technology) in light of that same uncertainty. In parallel, one might expect outcome *certainty*-related emotions (e.g., anger) to increase the chance that people form a closed attitude due to similar appraisal processes. The present data, however, did not reveal such an effect. It is possible that this observed null effect occurred because the overall degree to which participants reported experiencing these outcome certainty-related emotions was relatively low ($M = 2.06$, $SD = 1.12$, range: 1.00 to 5.60). Thus, there were few, if any, participants who actually indicated experiencing the emotions that might help them to achieve cognitive closure. This in itself could have made it difficult to statistically detect such a relation, especially if we assume the effect to emerge at higher levels of emotion intensity. Alternatively, it is possible that outcome certainty-related emotions simply are less relevant for the achievement of closure. Instead, such emotions might primarily relate to the content or *valence* of people's attitudes, rather than to their ability to achieve closure. In fact, our additional analysis of the relation between negative emotions and attitude valence suggests this might be the case.

The current study was conducted in a controlled laboratory setting among a student population and in the context of one specific complex technology. This raises valid questions about the generalizability of the current findings. In principle, a homogeneous sample—as used in the present study—is well suited for the purpose of examining the relations between lay risk perception, emotions, and cognitive closure. In fact, one may argue that the homogeneity of the sample is likely to suppress the variance observed and hence offers a conservative test of the relations examined. Nevertheless, it might be interesting to examine whether these same relations are observed in a broader sample that is more representative of the general population. Moreover, although the present research focused on factors that impact the formation of closed attitudes in the specific context of the complex technology of CCS, we have no reason to believe that the present findings are limited to this technology. Indeed, based on the theoretical argument presented here, and supported by our present data, we would anticipate that similar findings should be observed in the case of other complex technological

innovations that may raise uncertainty about risky outcomes, such as nanotechnology or bioengineering.

Conclusion

The public opinion can be decisive for the successful implementation of complex technologies. It is therefore important to understand under what circumstances people are likely to form a clear point of view—to achieve cognitive closure—and which factors impede them from making up their mind. In the present research, we revealed how risk perception and the experience of negative emotions—two responses that are commonly evoked when people are confronted with a complex technology—can reduce the level of cognitive closure that people achieve on the topic. The distinction between different dimensions of risk perception and different clusters of negative emotions moreover revealed which aspects of these responses are of particular importance for the achievement of cognitive closure. These results thus demonstrate that risk perception and negative emotions are not only relevant to attitude valence, but also to the *process of attitude formation*.

Chapter 3

Antecedents and Consequences of Achieving Cognitive Closure: The Ability to Achieve Closure, and Openness to Additional Information

This chapter is based on Koot, C., Ter Mors, E., Ellemers, N., & Daamen, D. D. L. (2014a). *Antecedents and consequences of achieving cognitive closure: The ability to achieve closure, and openness to additional information*. Manuscript submitted for publication.

Political affairs are affected by people's votes in elections. Novel technologies, such as genetic modification of food, can often only be implemented successfully with acceptance from the public. In other words, "what the people think" can be a decisive factor for the progress of various public affairs. Politicians and businesses have hence taken an interest in public opinions relevant to their decision making and policies. An important element to consider in this regard is the extent to which public opinions or attitudes towards such topics are "open" or "closed". Open, unfinished attitudes (cf., pseudo attitudes; Converse, 1964, 1970) are highly unstable and easily changed by contextual information (e.g., Strack, Schwarz, & Wänke, 1991), and they are thus not very predictive of public acceptance of novel policies or technologies. Closed, finished attitudes, on the other hand—attitudes about which people have achieved cognitive closure—are much more durable and thereby also better predictors of future attitudes and behavior (Bassili, 1996; Fazio & Zanna, 1978; Krosnick & Petty, 1995; Petty & Cacioppo, 1986b). It is hence important to establish which factors facilitate the achievement of cognitive closure, and to expand our understanding of the precise consequences that follow from the achievement of closure.

In this chapter we will extend existing knowledge on cognitive closure in two ways. First, we examine a novel antecedent of cognitive closure—the ability to achieve closure. Second, we investigate the consequences of the achievement of cognitive closure for people's openness to additional attitude-relevant information. Because the achievement of cognitive closure is particularly relevant in the context of multi-faceted, public issues, we will focus on attitude formation about complex topics in this research.

The Ability to Achieve Closure

Previous research on the achievement of cognitive closure has predominantly addressed the role of people's *need* for closure (e.g., Kruglanski, 1989, 1990; Kruglanski & Webster, 1991, 1996; Webster & Kruglanski, 1994, 1997). This perspective emphasizes that people tend to differ in their desire for a definite answer (i.e., for cognitive closure) and that this desire affects the extent to which they draw conclusions and hold on to these conclusions (Kruglanski & Webster, 1996). While research on the need for closure has provided important insights in people's tendency to form a closed attitude, the desire for a definite answer or conclusion may not always be the sole or most relevant determinant of the level of cognitive closure that people achieve. That is, even when people feel the *need* to finalize their attitude formation and achieve cognitive closure, they may not feel that they are *capable* of doing so (cf. Kossowska & Bar-Tal, 2013; Roets & Soetens, 2010). Particularly when the topic in question is highly complex, the sense of being able to make up one's mind may be an important antecedent of the

achievement of cognitive closure. In fact, this perceived ability may be as important for the level of closure that is achieved as the felt need to take a stance. We thus postulate that the perception that people have of their own ability to form a closed attitude plays a significant role in the actual achievement of cognitive closure, and define this *ability to achieve closure* as the perceived ability to make judgments and decisions confidently and with certainty (cf. Roets & Van Hiel, 2007; Roets et al., 2006).

The ability to achieve closure has been recognized in the literature as a potential influence on whether or not people actually achieve cognitive closure in their attitude formation about a given topic (cf. Roets & Soetens, 2010; Roets & Van Hiel, 2007). However, to our knowledge, the assumption of the impact of ability to achieve closure on the achievement of cognitive closure has not been explicitly tested until now. Previous research has primarily treated the ability to achieve closure as an individual difference variable (e.g., Kossowska & Bar-Tal, 2013; Roets & Soetens, 2010). However, a recent study provides initial evidence for the idea that the extent to which people feel able to achieve closure can also be determined by external, contextual factors (Kossowska et al., 2014), similar to the effects of contextual factors on people's need for closure (e.g., Kruglanski & Boyatzi, 2012; Mayseless & Kruglanski, 1987). Experimental manipulation of people's ability to achieve closure thus provides a possibility to investigate the role that this ability plays in the achievement of cognitive closure. The first goal of the present experimental research is therefore to examine whether it is possible to induce differences in the notion that people have of their general ability to achieve closure, to the extent that this leads to actual differences in the level of cognitive closure that they achieve in their attitude formation regarding a specific topic. We predict that the more people perceive themselves as well capable of making decisions and forming judgments, the more they will achieve cognitive closure in their attitudes on complex topics.

Consequences of Achieving Cognitive Closure for Openness to Additional Information

The second goal of the present research is to extend existing knowledge on the consequences of achieving a state of cognitive closure. It is known that variations in cognitive closure affect, for instance, the subsequent stability of an attitude (Bassili, 1996; Krosnick & Petty, 1995). However, it remains unclear what the implications are of the level of cognitive closure that people have achieved for the way in which they respond to additional information about the topic in question. In the realm of public opinion in particular, it is relevant to know whether and how the achievement of cognitive closure affects people's openness to additional information. For example, if people's receptivity to relevant input decreases once they have achieved cognitive closure, this has important

implications for the potential impact of public information campaigns.

To our knowledge, the relation between the level of cognitive closure that people have achieved and their openness to additional attitude-relevant information has so far not been explicitly examined. One would expect, however, that people who are still figuring out their point of view (i.e., who have not yet achieved cognitive closure) display an interest in and make use of information that can help them decide where they stand. Those who have rounded off their attitude formation (i.e., who have achieved cognitive closure), on the other hand, should feel less need for and be less interested in additional input. An initial indication for the validity of this reasoning comes from research by Kruglanski, Webster, and Klem (1993): Participants in three studies received information on a court case and were asked to form an initial judgment. Among participants who had received a complete set of information, those with a high, compared to a low need for closure subsequently achieved more cognitive closure and were less easily persuaded by another person actively advocating a different judgment. This suggests that the achievement of closure may reduce people's openness to new, relevant input. Furthermore, prior research has found that people who feel very little ambivalence on a topic—a potential indication of cognitive closure—are less interested in and make less use of relevant information than those who feel two-sided or ambivalent—which suggests a lack of cognitive closure (e.g., Jonas, Diehl, & Brömer, 1997; Zhao & Cai, 2008). We therefore predict that that the more people have achieved cognitive closure, the less they are open to additional attitude-relevant information.

The Present Research

The goals of the present research are twofold. First, we will examine a novel antecedent of cognitive closure—the ability to achieve closure. Second, we will investigate the consequences of achieving cognitive closure for people's openness to additional attitude-relevant information. We will pursue these goals in two experimental studies, in which we propose and test a causal chain from ability to achieve closure through cognitive closure achieved to openness to additional attitude-relevant information (see Figure 3.1). In both studies, participants will receive bogus test feedback which induces the self-image of having either a high or a moderate ability to achieve closure on complex topics. Participants will then form an attitude

towards the specific complex topic of carbon capture and storage technology (CCS)[4], after which we assess their level of cognitive closure achieved and their openness to additional information on the topic (opinionative information in Study 3.1; opinionative information versus factual information in Study 3.2). We test the following hypotheses:

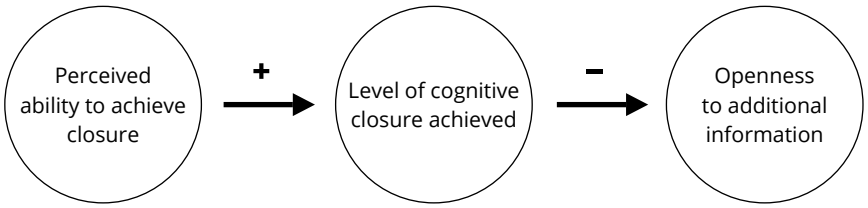
H1. People who are led to believe that they have a high ability to achieve closure will achieve more cognitive closure in their attitude formation compared to people who are led to believe that they have a moderate ability to achieve closure.

H2. Level of cognitive closure achieved is inversely related to openness to additional attitude-relevant information. This entails that the more people have achieved cognitive closure in their attitude formation, the less open they are to additional information on the topic.

H3. Ability to achieve closure indirectly influences openness to additional attitude-relevant information through cognitive closure achieved.

Figure 3.1.

The proposed indirect effect of the manipulation of ability to achieve closure on openness to additional information through level of cognitive closure achieved



4 CCS is a climate change mitigation technology that is considered important for stabilizing greenhouse gas concentrations in the atmosphere (IPCC, 2007). The technology involves the capture of CO2 produced in power plants or other industrial sources, transportation of the CO2 to underground storage sites (e.g., depleted oil and gas fields), and long-term storage in these sites. As with other complex technologies, public acceptance is a critical factor in the successful implementation of CCS (e.g., Markusson et al., 2011; Terwel et al., 2012).

Study 3.1

Method

Participants and design

Forty-two social science and humanities students (14 men and 28 women, M_{age} = 21.17, SD = 3.30) from Leiden University participated in this study and were randomly assigned to either the high ability to achieve closure (high AAC) condition or the moderate ability to achieve closure (moderate AAC) condition. Participants received a monetary reward or course credit in return for their participation.

Procedure

This study was the first in a series of unrelated studies. Upon arrival at the laboratory, participants were led to individual cubicles, each containing a PC on which the study would be conducted. Participants read a brief introductory text to the study, describing it as an investigation of people's judgment and decision making habits and opinion formation concerning complex topics. The first part of the study consisted of a test that was ostensibly designed to assess participants' judgment and decision making habits. After completing the test, participants were told that their personal results from the test had to be computed. In the meantime, participants were introduced to the second part of the study, which was described as investigating the processes that occur when people form their opinion on a concrete, real-life complex topic; the implementation of carbon capture and storage technology (CCS) in the Netherlands. Participants learned that they would be asked to form their opinion regarding this complex topic. They read a brief introductory text on CCS that provided basic information about the technology, which was largely based on the text previously used by Ter Mors and colleagues (2010).

After reading the introductory text, participants received the bogus feedback from the test which served as the manipulation of participants' perceptions of their ability to achieve closure (AAC) in the context of complex topics. In both conditions, participants were told that they were "judgment and decision making Type A". In the high AAC condition, the feedback described participants as generally making judgments and decisions confidently and with certainty. Specifically, participants in this condition read that being "Type A" means that, more than others, they tend to make decisions and form attitudes about complex topics with confidence and without hesitation. Their decisions were described as constant and stable. Participants in the high AAC condition were also told that they tend to experience certainty regarding their opinions,

and that they display an above average level of decisiveness when forming opinions about complex and intricate topics. We suspected that describing participants' ability to achieve closure as low in the second experimental condition (e.g., "you display little confidence and certainty when making decisions and forming attitudes") would be perceived negatively and potentially cause participants to object to the validity of the test results provided (i.e., cause reactance). We therefore chose to portray participants' ability to achieve closure in the second experimental condition as moderate, which we deemed a more appropriate level. Thus, in the moderate AAC condition, the feedback described participants' judgments and decision making in terms of moderate certainty and confidence. That is, participants in this condition read that being "Type A" means that, more than others, they tend to take decisions not too quickly and try to form their opinions about complex topics in a careful manner. They were also told they do not commit themselves quickly to one point of view. Participants in the moderate AAC condition were furthermore told that they may experience uncertainty regarding their opinion, and that their carefulness and cautiousness is above average when forming opinions. Finally, participants in both experimental conditions were told that "Type A" was a functional decision-style. They also learned that the result of the test has good predictive value for many complex decisions that they will have to make in daily life, and that the test is often used for assessments in various business sectors. After receiving the bogus feedback, participants completed the manipulation checks, and read an additional brief text on CCS in which the main argument of CCS-opponents and the main argument of CCS-proponents in the Netherlands were described. Participants next completed a behavioral measure and a cognitive (self-report) measure that tapped into their level of cognitive closure achieved concerning the topic of CCS. Finally, participants completed measures of openness to additional information about CCS as well as a number of control measures.

Measures

Manipulation checks. To check whether participants had understood the bogus feedback correctly, they were asked to indicate which feedback they had received from the test. The first question asked them to indicate which decision making type they were according to the feedback (decision Type A, B, C, or D). The second question asked participants to indicate whether this implied that they were above or below average in their decisiveness (in the high AAC condition) or in their carefulness and cautiousness (in the moderate AAC condition).

Control measures. We wanted to rule out the possibility that effects of our experimental manipulation might be accounted for by (pre-existing) differences in need

for closure or self-efficacy, since such differences could contribute to variations in the achievement of cognitive closure (e.g., Bandura, 1977; Webster & Kruglanski, 1994). Thus, need for closure and self-efficacy were assessed as control variables at the end of the study (presented to participants as an unrelated study on personality). We assessed need for closure using the revised 15-item need for closure scale developed by Roets and Van Hiel (2011) (α = .87). Self-efficacy was measured by means of the Dutch adaptation of the general self-efficacy scale (Teeuw, Schwarzer, & Jerusalem, 1994), which consists of 10 items (α = .72). Higher scores on the 7-point scales indicate higher levels of need for closure or higher self-efficacy.

Cognitive closure achieved. We assessed both cognitive and behavioral manifestations of the level of cognitive closure that participants had achieved concerning their attitude on CCS. Although closure is in the first place a cognitive state, we also expected closure to be manifested behaviorally. When people have achieved cognitive closure about a certain topic, this means that they believe they have finished their attitude formation process and that they feel confident about their attitude. Such confidence should then also include feeling comfortable with committing to the finished attitude.

The cognitive measure of cognitive closure achieved consisted of a questionnaire which contained 13 items. Participants were asked to indicate their agreement with statements regarding their attitude on the implementation of CCS in the Netherlands, such as "I am certain of my opinion on the implementation of carbon capture and storage technology in the Netherlands", "I feel undecided about my opinion on carbon capture and storage technology" (reverse-coded), and "My opinion on the implementation of carbon capture and storage technology in the Netherlands is fixed" (ranging from 1 = *completely disagree*, to 7 = *completely agree*). A cognitive closure score was calculated by averaging participants' responses to the items (α = .82); higher scores on the scale indicate higher levels of cognitive closure achieved.

The behavioral measure of cognitive closure achieved asked participants to indicate whether or not they were ready to participate in a poll concerning the implementation of CCS in the Netherlands (1 = *I am ready to participate*; 2 = *I am not yet ready to participate*). The results of this poll would ostensibly be forwarded to governmental organizations involved in the implementation of CCS in the Netherlands. After indicating whether they were ready to participate, participants who answered affirmatively could vote for or against the implementation of CCS in the Netherlands. Participants' choice whether or not to participate in the poll (i.e., commit to their attitude) was used as a behavioral measure of cognitive closure achieved, in which readiness to participate was considered an indicator of cognitive closure.

Openness to additional information. After participants had completed the measures of cognitive closure achieved, we assessed their interest in and use of additional information on CCS.

Interest in additional information. We announced that participants would be asked to explain their attitude towards the implementation of CCS in the Netherlands in writing for the purpose of providing participants of future studies with these explanations. Before they were to write this explanation, participants were presented with the opportunity to read additional information on CCS that supposedly originated from the internet (e.g., websites, forums, and discussion platforms) and was provided by proponents and opponents of CCS. The information was presented by means of a computerized information display board, as developed by Ter Mors and colleagues (2010). In this information display board, links to fourteen arguments concerning the implementation of CCS were presented in a matrix; seven arguments were categorized as being provided by proponents of CCS and seven were categorized as being provided by opponents. By clicking on a link to an argument, participants could read one or two sentences that explained the chosen argument. They could consult as many (or as few) arguments as they liked. The number of arguments that participants selected to read served as a behavioral indicator of their interest in additional information.

Use of additional information. After participants had had the opportunity to read the additional information on CCS in the information matrix, they were asked to indicate their attitude towards the implementation of CCS in the Netherlands (1 = *very negative*, 7 = *very positive*; overall $M = 3.53$, $SD = 1.40$) and to write an explanation of this attitude. We used the content of these explanations as an indicator of participants' use of the additional information that they had selected in the information matrix. Two independent raters (blind to experimental conditions) counted the number of arguments that participants had used to explain their point of view, and classified the arguments into two categories: arguments related to the information in the matrix (i.e., matrix-related arguments) and "other" arguments (i.e., with content unrelated to the information in the matrix). Correspondence between raters was high (91%) and differences were resolved through discussion[5]. Use of the additional information was operationalized as the proportion of arguments in participants' explanation that consisted of matrix-related arguments. This proportion was computed by dividing the number of matrix-related arguments by the total number of arguments that a participant had used in their explanation. Potential scores on the use of additional information

5 We checked whether arguments that had been classified as matrix-related by both raters had been selected in the information matrix by the participants or coincidentally converged with matrix information which participants had not consulted. The large majority (87%) of classifications had indeed been consulted by the participants in the matrix. The residual 13% was reclassified as "other".

measure thus ranged from 0 (indicating that 0% of a participant's explanation consisted of matrix-related arguments) to 1 (indicating that 100% of a participant's explanation consisted of matrix-related arguments). Because two participants did not provide any arguments in their explanations, their score for the information use measure could not be computed. As a result, the analyses on this measure as reported below were conducted on the data of the remaining 40 participants.

Results

Manipulation checks

All participants (100%) correctly indicated the decision making type they were according to the bogus test feedback they had received (decision Type A). Furthermore, all participants (100%) correctly indicated that they had scored above average on the relevant characteristic (i.e., decisiveness in the high AAC condition, and carefulness and cautiousness in the moderate AAC condition). This implies that we were successful in inducing the conviction among participants that their ability to achieve closure was either high or moderate.

Control measures

Analysis of Variance (ANOVA) showed that there was no difference between participants in the two experimental conditions in self-reported levels of need for closure and self-efficacy, Fs$(1, 40) \leq 1.65$, ps $\geq .206$. Furthermore, when need for closure and self-efficacy were added as covariates to our analyses of the effect of the AAC manipulation on the measures of cognitive closure achieved, the pattern of results did not change. Thus, effects of the experimental manipulation cannot be explained by systematic differences between conditions in need for closure and self-efficacy. We also checked whether correcting for individual differences in need for closure and self-efficacy affected the nature of the relation between cognitive closure achieved and openness to additional information. This was not the case.

Test of hypotheses

To investigate whether our manipulation of ability to achieve closure affected cognitive closure achieved, we first performed an ANOVA on the self-report scale of cognitive closure achieved. This analysis revealed a significant effect of the experimental manipulation, $F(1, 40) = 5.95$, $p = .019$, $\eta_p^2 = .13$. Participants who were led to believe that they had a high ability to achieve closure reported to have achieved significantly more cognitive closure in their attitudes on CCS ($M = 4.13$, $SD = 0.88$) compared to participants who were led to believe that they had a moderate ability to achieve closure ($M = 3.47$, $SD = 0.87$), thereby confirming Hypothesis 1.

A chi-squared test on participants' responses to the behavioral measure of cognitive closure achieved (i.e., the decision of whether or not to partake in the poll on CCS) also revealed a marginally significant effect of the experimental manipulation, $\chi^2(1) = 3.58$, $p = .059$. Participants who were led to believe that they had a high ability to achieve closure were more often inclined to vote in the poll on CCS—and thereby commit to their attitude—(70% of participants in this condition decided to cast a vote) compared to those who were led to believe that they had a moderate ability to achieve closure (41% of participants in this condition decided to cast a vote), indicating a higher level of cognitive closure achieved in the former group. These results offer further support for Hypothesis 1.

To check whether or not the behavioral measure of cognitive closure achieved (i.e., the decision to partake in the poll) was related to the cognitive (self-report) measure of cognitive closure achieved—and thus tapped into the same construct—we computed the point-biserial correlation between the two measures. Before the analysis we reverse-coded the poll measure (1 = *not yet ready to participate in the poll*; 2 = *ready to participate in the poll*) to facilitate the interpretation of the correlation. Results of the analysis indeed showed a significant and positive correlation between the two measures of cognitive closure achieved ($r_{pb} = .75$, $p < .001$), such that participants who had chosen to participate in the poll reported higher levels of closure achieved on CCS, compared to participants who had opted not to partake in the poll.

The second hypothesis stated that level of cognitive closure achieved is inversely related to openness to additional attitude-relevant information. To test this hypothesis, we conducted linear regression analyses with self-reported level of cognitive closure achieved on CCS as predictor variable and interest in and use of additional CCS information as dependent variables. Results showed that the more that participants had achieved cognitive closure in their attitudes concerning CCS, the fewer arguments they selected to read in the CCS information matrix, $\beta = -.39$, $t(40) = -2.68$, $p = .011$, and the less they used this information in their attitude-explanation, $\beta = -.40$, $t(38) = -2.70$, $p = .010$[6]. Thus, Hypothesis 2 was also supported.

Next, we followed bootstrapping procedures using Preacher and Hayes' (2008) approach (5000 resamples, bias corrected) to examine whether our experimental manipulation of ability to achieve closure (AAC) had an indirect effect on openness

6 One might argue that the results on use of additional information are a mere reflection of the fact that participants with higher levels of cognitive closure achieved selected fewer arguments in the matrix than participants with lower levels of closure achieved. To exclude this possibility, we ran the same regression analysis, but this time we controlled for the total number of arguments that participants had selected in the matrix. Results of this analysis showed that the relation between cognitive closure achieved and use of additional information was somewhat reduced, but remained marginally significant, $\beta = -.26$, $p = .091$. This indicates that cognitive closure achieved is indeed inversely related to use of additional information.

to additional attitude-relevant information through (self-reported) level of closure achieved (Hypothesis 3). No total effect of the AAC manipulation on interest in and use of additional information on CCS was observed (information interest analysis: $B = 0.02$, $p = .993$; information use analysis: $B = 0.05$, $p = .651$). However, results of the analyses indeed showed a significant indirect effect of the AAC manipulation through cognitive closure achieved on interest in additional information on CCS ($B = -1.55$; 95% CI [−4.05, −0.30]), and on use of additional information on CCS ($B = -0.13$; 95% CI [−0.32, −0.03]), thereby supporting Hypothesis 3[7]. Consistent with Hypothesis 1 and Hypothesis 2 and the results reported above, ability to achieve closure (0 = moderate, 1 = high) predicted the achievement of cognitive closure on CCS (information interest analysis: $B = 0.66$, $p = .019$; information use analysis: $B = 0.77$, $p = .008$[8]). In turn level of cognitive closure achieved predicted a reduced interest in additional information on CCS ($B = -2.35$, $p = .007$) and a reduced use of additional information on CCS ($B = -0.17$, $p = .002$).

Discussion

The results of Study 3.1 offer clear support for all three hypotheses. The results corroborate the notion that people's perceptions of their own general ability to achieve cognitive closure can be externally influenced. Moreover, this study demonstrates that the perceptions that people have of their ability to achieve closure affect the level of cognitive closure that they actually achieve when forming an attitude towards a specific complex topic. That is, results of Study 3.1 show that people achieve more closure in their attitude formation towards a specific complex topic when they are led to believe that their ability to achieve closure is high rather than moderate.

Furthermore, Study 3.1 shows that the more people achieve cognitive closure, the less they are open to additional information on the topic in question. Specifically, an increase in level of cognitive closure achieved was found to be negatively related to both interest in and use of additional attitude-relevant information. Bootstrapping mediation procedures, moreover, demonstrated the predicted indirect effect of ability to achieve closure on openness to additional attitude-relevant information through level of cognitive closure achieved. Together these findings support our argument that the level of cognitive closure that people achieve is determined by the extent to which they

7 See Preacher and Hayes (2008) and Rucker, Preacher, Tormala, and Petty (2011) for discussion and approval of indirect effects in the absence of a significant total effect.

8 Information use-values for two participants were missing which lowered the degrees of freedom in the analysis of the indirect effect on information use. The effect of the experimental manipulation on cognitive closure achieved in the analysis of information use therefore differs slightly from that in the analysis on information interest.

perceive themselves capable of doing so, with important consequences for their openness to additional information.

Study 3.2

The goal of Study 3.2 was twofold. The first goal was to replicate the results of Study 3.1; the research design in Study 3.2 was similar to that in the previous study and the same hypotheses were tested. The second goal was to shed more light on the negative relation between the level of cognitive closure that people achieve and their openness to additional attitude-relevant information that was predicted and found in Study 3.1.

Arguably, the additional information on the attitude topic (i.e., carbon capture and storage technology or CCS) in Study 3.1 was opinionative in nature, as it was presented to the participants as a compilation of arguments that originated from the internet which are used by proponents and opponents of CCS. We hence do not know whether our finding in Study 3.1 regarding the negative relation between cognitive closure achieved and openness to additional attitude-relevant information only holds for information that is opinionative in nature (i.e., information primarily pertaining people's opinions), or may also extend to factual information (i.e., information that primarily concerns and discusses facts). This is what we explored in the present study. For this purpose we presented participants with the opportunity to read additional opinionative information on the topic of CCS as well as additional factual information on CCS.

People are likely to use cues, or heuristics, to help themselves make judgments and decisions when they are not particularly involved or interested in the complex topic in question (Chaiken, 1980; Petty & Cacioppo, 1986a). Opinionative information can provide such cues, as it overtly presents a possible position on the topic. People who are forming their attitude may thus regard others' opinions as cues and suggestions for their own viewpoint. In line with this reasoning, previous research has shown that people who are still trying to make sense of a certain topic value others' opinions highly (Crano & Prislin, 2006; Kruglanski, Dechesne, Orehek, & Pierro, 2009). Moreover, research on the consequences of attitude certainty—a concept related to cognitive closure—has shown that the more people feel certain about their attitude, the less easily the content of their attitude is influenced by information propagating a specific point of view (Petrocelli, Tormala, & Rucker, 2007). This suggests that those who have achieved cognitive closure have really closed off their attitude to the viewpoints of others. Thus, those who have achieved cognitive closure, and have decided on their attitude, should display less interest in additional information that is directive and opinionative in nature than people who have not yet achieved closure. We indeed found support for this reasoning

in Study 3.1. The question is whether the achievement of cognitive closure is also, and in a similar way, related to people's openness to factual information. Although conclusions and viewpoints can be deduced from factual information about complex issues, this deduction must be performed by people themselves, which suggests that factual information does not provide (easy) heuristics for an attitudinal position. In Study 3.2 we thus explored the possibility that the negative relation between cognitive closure achieved and openness to additional attitude-relevant information in particular holds for information that is opinionative in nature and not so much for information that is factual in nature.

Method

Participants and design

Participants were 57 students (25 men and 32 women, M_{age} = 21.65, SD = 2.47) from Leiden University who studied humanities, social sciences, or bio-medical science. They were randomly assigned to either the high ability to achieve closure (high AAC) condition or the moderate ability to achieve closure (moderate AAC) condition. Participants received either a monetary reward or course credit in return for their participation.

Procedure

This study was the first in a series of unrelated studies. The procedure of Study 3.2 was nearly identical to Study 3.1, the distinction being that the measures of openness to additional information were different from those used in Study 3.1. The manipulation of ability to achieve closure was identical to that in Study 3.1, and as in Study 3.1 participants formed an attitude towards the complex topic of carbon capture and storage technology (CCS). The introduction to the topic and the information that participants received on CCS prior to completing the measures of cognitive closure achieved were also identical to that in Study 3.1.

Measures

Manipulation checks. To check whether participants had understood the bogus test feedback correctly, we used the same two manipulation checks as in Study 3.1.

Control measures. As in Study 3.1, need for closure and self-efficacy were measured as control variables at the end of the study (presented to participants as an unrelated study on personality). We employed the same need for closure scale (α = .85) and self-efficacy scale (α = .88).

Cognitive closure achieved. The cognitive (self-report) measure and behavioral measure of cognitive closure achieved consisted of the same questionnaire (α = .90) and

the same poll measure that we used in Study 3.1. As in Study 3.1, participants first made choices regarding the poll, after which they answered the questions in the questionnaire.

Openness to additional information. After participants had completed the measures of cognitive closure achieved, we assessed their interest in additional opinionative information on CCS and their interest in additional factual information on CCS. We asked participants to explain their attitude towards the implementation of CCS in the Netherlands in writing, allegedly to be able to provide participants of future studies with these explanations. Before they were to write this explanation, participants were asked to indicate their interest in reading additional information on CCS. They ostensibly would be allowed to read this information before writing the explanation of their attitudes.

Interest in opinionative information. The measure of interest in additional opinionative information on CCS consisted of a list of transcripts of 10 fictitious television interviews. In order to convey the opinionative nature of the information, participants learned that the interviews were conducted with various people who expressed their opinions on CCS and related topics. The list of interviews that was presented to participants contained descriptions such as "Interview with CEO of a power plant" and "Interview with inhabitants of a potential CO_2 storage site". Participants first indicated for each interview to what extent they were interested in reading a transcript of the interview (1 = *not at all interested*, 7 = *very much interested*). Then, participants selected the interview transcripts that they wanted to read. We computed two indicators of interest in additional opinionative information; first, we averaged the interest ratings of the 10 interviews ($\alpha = .81$) and second, we counted the number of interview transcripts that each participant had selected to read.

Interest in factual information. The measure of interest in additional factual information followed the same format as the measure of interest in additional opinionative information, only this time the list that was presented to participants contained 10 fictitious titles of newspaper articles that allegedly had been published in national newspapers. The list contained titles indicating the factual nature of the information reported in the articles, such as "Decisions on energy in Western Europe", "Permission for a test of CO_2 storage", and "The role of CO_2 in climate issues". Identical to the measure of interest in additional opinionative information, participants indicated for each article their interest in reading it (1 = not at all interested, 7 = very much interested), after which they selected the articles that they wanted to read. Two indicators of interest in factual information were computed; first we averaged the interest ratings of the ten articles ($\alpha = .75$) and second, we counted the number of articles that each participant had selected to read. The order in which the measures of interest

in opinionative information and interest in factual information were completed was counterbalanced across participants9.

Next, the participants learned that the articles and interview transcripts that they and the other participants in the study had chosen to read would be assembled, and that in the mean time they would continue with the current study and the other studies in the session. After these other studies, participants would allegedly have the opportunity to read the interview transcripts and the newspaper articles they had selected (if applicable) before writing their definite attitude explanation. At this point in the study, participants were asked to write a tentative explanation of their view on CCS, which they allegedly could adjust at a later point (i.e., after reading the articles and interview transcripts). In Study 3.2, this (tentative) explanation supported the cover story of the study but did not function as a dependent variable. Next, participants completed the control measures which again were presented as an unrelated study on personality. At end of the series of studies that participants participated in, they were debriefed and informed that they would actually not be provided with the articles and transcripts of interviews they had chosen to read, and that no further definite attitude explanation on CCS would have to be given.

Results

Manipulation checks

All participants (100%) correctly indicated the decision making type they were according to the bogus test feedback they had received (decision Type A). Furthermore, all participants (100%) correctly indicated that they had scored above average on the relevant characteristic (i.e., decisiveness in the high AAC condition, and carefulness and cautiousness in the moderate AAC condition). This implies that we were successful in inducing the conviction among participants that their ability to achieve closure was either high or moderate.

Control measures

Replicating the results from Study 3.1—and as intended—Analysis of Variance (ANOVA) showed that there was no difference between experimental conditions in self-

9 We conducted ANOVAs with the AAC manipulation and counterbalance order as independent variables, and the measures of openness to additional opinionative and openness to additional factual information as dependent variables. There was only a main effect of counterbalance order on the two measures of openness to opinionative information, $Fs(1, 53) \geq 6.08$, $ps \leq .017$, $\eta_p^2 s \geq .10$, such that participants who were first presented with the list of newspaper articles (factual information) were less interested in the interviews ($M = 2.73$, $SD = 0.90$) and selected fewer interviews ($M = 2.43$, $SD = 2.24$) than those who first were presented with the list of interviews (opinionative information) ($M = 3.40$, $SD = 1.04$, and $M = 3.78$, $SD = 1.76$, respectively). No other effects were significant.

reported levels of need for closure and self-efficacy, Fs(1, 55) < 1, ps ≥ .684. Furthermore, when need for closure and self-efficacy were added as covariates to our analyses of the effect of the AAC manipulation on the measures of cognitive closure achieved, the pattern of results did not change. Thus, the results of our experimental manipulation cannot be explained by and emerged independently of (pre-existing) differences in need for closure and self-efficacy. We also checked whether correcting for individual differences in need for closure and self-efficacy affected the nature of the relation between cognitive closure achieved and openness to additional opinionative and factual information. This was not the case.

Test of hypotheses

We ran an ANOVA on the cognitive closure self-report scale to test our prediction that, compared to participants in the moderate AAC condition, participants in the high AAC condition would indicate higher levels of cognitive closure achieved concerning the implementation of CCS in the Netherlands (Hypothesis 1). As in Study 3.1, results confirmed that participants who were led to believe that they had a high ability to achieve closure reported to have achieved significantly higher levels of cognitive closure on the topic of CCS (M = 4.52, SD = 1.01) than participants who were led to believe that they had a moderate ability to achieve closure (M = 3.90, SD = 1.05), $F(1, 55) = 5.06$, $p = .028$, $\eta_p^2 = .08$. A chi-squared test on participants' responses to the behavioral measure of cognitive closure achieved did not reveal a significant effect of the experimental manipulation of ability to achieve closure, however. That is, unlike in Study 3.1, results revealed no difference between the high AAC condition and the moderate AAC condition in participants' inclination to participate in the poll on CCS, $\chi^2(1) = 0.34$, $p = .561$.

To check whether, as in Study 3.1, the behavioral measure of cognitive closure achieved (i.e., the decision to partake in the poll) was related to the cognitive (self-report) measure of closure achieved—and thus tapped into the same construct—we computed the point-biserial correlation between the two measures. Before the analysis we reverse-coded the poll measure (1 = *not yet ready to participate in the poll*; 2 = *ready to participate in the poll*) to facilitate the interpretation of the correlation. Consistent with our reasoning, and with the results from Study 3.1, the poll-measure was significantly and positively related to the self-report measure of cognitive closure achieved ($r_{pb} = .51$, $p < .001$), such that participants who had chosen to participate in the poll reported higher levels of closure achieved on CCS compared to participants who had decided not to partake in the poll.

We then tested Hypotheses 2 and 3. Hypothesis 2 stated that level of cognitive

closure achieved is inversely related to openness to additional attitude-relevant information. Hypothesis 3 predicted an indirect effect of ability to achieve closure (AAC) on openness to additional attitude-relevant information through (self-reported) level of cognitive closure achieved. We furthermore explored the possibility that Hypotheses 2 and 3 would specifically apply to additional information that is opinionative in nature (i.e., the type of information that was offered in Study 3.1), and not so much for factual information.

We first report results for openness to additional opinionative information. As a test of Hypothesis 2, we conducted linear regression analyses with self-reported level of cognitive closure achieved as predictor variable, and interest in interview transcripts and number of interview transcripts selected to read as dependent variables. Results revealed that the more participants had achieved cognitive closure in their attitudes concerning CCS, the less interested they were in reading the interview transcripts on CCS, $\beta = -.24$, $t(55) = -1.86$, $p = .068$, and the fewer interview transcripts on CCS they selected to read, $\beta = -.29$, $t(55) = -2.20$, $p = .032$. This is consistent with our rationale and with the results from Study 3.1. We then followed bootstrapping procedures using Preacher and Hayes' (2008) approach (5000 resamples, bias-corrected) to examine whether the manipulation of ability to achieve closure (AAC) had an indirect effect on openness to additional opinionative information through self-reported level of cognitive closure achieved (Hypothesis 3). No total effect of the AAC manipulation on interest in interview transcripts on CCS and number of interview transcripts selected was observed (information interest analysis: $B = 0.34$, $p = .207$; information selection analysis; $B = 0.14$, $p = .802$). However, results of the analyses did show a significant indirect effect of the AAC manipulation on interest in interview transcripts on CCS ($B = -0.18$; 95% CI [−0.48, −0.04]) as well as on selection of interview transcripts on CCS ($B = -0.39$; 95% CI [−0.99, −0.05]) through cognitive closure achieved. Consistent with Hypotheses 1 and 2 and with the previously reported results, ability to achieve closure (0 = moderate, 1 = high) induced the achievement of cognitive closure on CCS ($B = 0.61$, $p = .029$). In turn, level of cognitive closure achieved predicted a reduction in interest in the interview transcripts on CCS ($B = -0.30$, $p = .020$) and a reduction in the number of interview transcripts that participants selected to read ($B = -0.64$, $p = .021$). Thus, as in Study 3.1 and as predicted in Hypotheses 2 and 3, we found an inverse relationship between cognitive closure achieved and openness to additional attitude-relevant (opinionative) information, as well as an indirect effect of our AAC manipulation on openness to additional attitude-relevant (opinionative) information through cognitive closure achieved.

We then conducted identical analyses for openness to additional factual

information. We first performed linear regression analyses with self-reported level of cognitive closure achieved as predictor variable and interest in newspaper articles and number of articles selected to read as dependent variables. Level of cognitive closure achieved on CCS did not emerge as a reliable predictor of interest in newspaper articles on CCS, $\beta = -.15$, $t(55) = -1.11$, $p = .271$, or the number of newspaper articles on CCS selected, $\beta = .06$, $t(55) = 0.46$, $p = .649$, as anticipated. The absence of a relation between cognitive closure achieved and openness to additional factual information excluded the possibility of an indirect effect of the AAC manipulation on openness to additional factual information through level of cognitive closure achieved.

Discussion

The results of Study 3.2 largely replicate and extend those of the first study, and offer further support for all three hypotheses. The results show that the extent to which people see themselves as capable of making up their mind positively affects the level of cognitive closure that they manage to achieve. As in Study 3.1, we found a clear relation between the cognitive (i.e., self-report) measure of cognitive closure achieved and the behavioral measure of the same construct (i.e., readiness to participate in a poll). In Study 3.1, however, participants in the high AAC condition reported more closure achieved and were somewhat more often willing to commit to their attitude (i.e., to participate in the poll) than those in the moderate AAC condition. The results of Study 3.2, on the other hand, only revealed an effect of our AAC manipulation on the cognitive measure of cognitive closure achieved, and not on the behavioral measure.

Study 3.2 further replicates and extends the results of the previous study by showing that the level of cognitive closure that people achieve is specifically consequential for their openness to additional attitude-relevant information that is opinionative in nature and not so much for their openness to additional factual information. Consistent with the results from Study 3.1, we found that the more people have achieved cognitive closure concerning a specific complex topic, the less they are open to additional information that is opinionative and that may thus direct or guide them in forming a definite attitude. Furthermore, we again found an indirect effect of our manipulation of ability to achieve closure on additional opinionative information through level of cognitive closure achieved.

General Discussion

The public's opinion can be a decisive factor in the progress of various public affairs, such as the implementation of governmental policies or of novel technologies. It is hence important to understand under which circumstances people will form their definite attitude—or achieve cognitive closure—as well as what the precise psychological consequences are of forming such a closed attitude. The present research therefore first, examined a novel antecedent of cognitive closure—the perceived ability to achieve closure—and second, investigated the consequences of achieving cognitive closure for people's openness to additional attitude-relevant information.

In the two experimental studies reported here, we manipulated participants' perceptions of their own ability to achieve closure by providing them with false feedback from a test that ostensibly assessed their judgment and decision making habits regarding complex topics. Next, participants formed an attitude towards a specific complex topic. Our results demonstrate that the extent to which people perceive themselves as able to achieve closure affects the level of cognitive closure that they actually achieve in their attitude formation, with important consequences for their openness to additional information on the topic in question. That is to say, the present research shows that people who are led to believe that they are well capable of making up their mind about complex topics actually form a more closed attitude about a specific complex topic than people who view themselves as less able to do so. As a result of this higher level of cognitive closure achieved, people are less open to additional attitude-relevant information that is opinionative in nature and contains other people's viewpoints and opinions. People's openness to *factual* information, on the other hand, appears to be unaffected by the level of cognitive closure that they achieve. Notably, the effects found in the present research emerged independently of individual differences in need for closure and self-efficacy, highlighting the importance of the ability to achieve closure in attitude formation.

Together the present findings support our argument that people's perceived ability to achieve closure is an important antecedent of the achievement of cognitive closure. Furthermore, our results demonstrate that the level of cognitive closure that people have achieved is inversely related to their openness to additional opinionative information about the topic in question.

Theoretical and Practical Implications

Research on cognitive closure has so far primarily focused on the need to achieve closure as a precursor of the achievement of closure, while the ability to achieve closure

has only been recognized as a potential antecedent (cf. Roets & Soetens, 2010; Roets & Van Hiel, 2007). Our findings extend the existing literature on cognitive closure (e.g., Kruglanski et al., 2009; Kruglanski & Webster, 1996; Webster & Kruglanski, 1994, 1997) by demonstrating that not only the felt *need* to achieve closure, but also the extent to which people perceive themselves as *able* to achieve closure is an important influence on the level of cognitive closure that people achieve. Importantly, the ability to achieve closure appears to be independent of people's need for closure. This implies that there may be circumstances under which people find themselves in a conflicting state with regard to their attitude formation: they may experience a need to finalize their attitude formation on a specific topic, while at the same time feeling incapable of doing so (cf. Kossowska et al., 2014).

We emphasize that the ability to achieve closure is subjective in nature, that is; the ability to achieve closure reflects the image that people have of their own capacity to make up their minds. Importantly, this approach differs from research on cognitive or mental ability, such as research on ego depletion, which generally considers people's mental strength or capacity to perform a certain act as an objective (and finite) source or force (e.g., Vohs, Baumeister, & Schmeichel, 2012; Vohs et al., 2008). The subjective nature of the ability to achieve closure implies that people may feel (un)able to perform a certain cognitive act independently of their relevant knowledge, intellect, or cognitive resources. This may explain the phenomenon that people sometimes take a definite stance on a topic that they actually do not understand well or about which they know very little.

The present studies demonstrate that the image that people have of their own ability to form a definite, closed attitude is not stable and that it can be influenced by external factors—in our case by bogus test feedback. The external influence on people's ability to achieve closure in the present studies was artificial (cf. Kossowska et al., 2014). However, there may very well be circumstances in everyday life that affect whether or not people feel able to make up their minds. It may, for instance, matter *who* is providing the information on a specific complex topic (i.e., characteristics of the source of information). That is, people may feel more capable of achieving cognitive closure on the basis of expert information than on the basis of information that originates from a non-expert source (cf. source expertise effects in persuasion: Cialdini & Goldstein, 2004; Pornpitakpan, 2004). Examining real-life influences on people's ability to achieve closure would further increase our understanding of when and why people form their definite attitudes about complex public issues. Future research along these lines might provide communicators with tools that encourage people to form a final viewpoint, or achieve cognitive closure, in their attitude formation.

We must note that although achieving closure is an important aspect of people's attitude formation, it is not necessarily a positive outcome. Ideally, people are thoroughly and well informed before forming a definite, closed attitude. However, we know that many frequently base their points of view on low quality, false, or limited information (e.g., Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012). This was also to some extent the case in the current research, as a substantial part of participants reported to have achieved a high level of cognitive closure after having received relatively little information on the complex topic in question (basic information on carbon capture and storage technology). In addition, our findings reveal that level of cognitive closure achieved has important consequences for people's openness to additional opinionative information on the topic in question. Specifically, the more that people have finalized their attitude formation, the less they are open to information that possibly discusses or propagates an alternative viewpoint. This means that having a closed attitude can be a hindrance when new arguments—which potentially offer reasons to reconsider one's position—become available. For instance, a politician will experience difficulty informing the public about the reasons motivating a specific policy when the public has already decided where they stand. Our results, on the other hand, reveal that people's openness to factual information is likely to remain constant, regardless of the level of cognitive closure that people have achieved. This suggests that in situations in which relevant knowledge is still being developed, for instance in the case of a fairly novel, complex technology like carbon capture and storage, it may be helpful to present newly available knowledge as facts rather than as arguments supporting a specific viewpoint, since receptivity to factual information will be equal for those who have and those who have not yet made up their mind.

Limitations and Future Directions

In this research we manipulated ability to achieve closure by means of bogus test feedback. To avoid reactance to the feedback, participants' ability to achieve closure was either described as high or moderate, but not low. We would argue that similar findings as in the present research can be obtained with a manipulation of ability to achieve closure that induces the perception that people's ability to achieve closure is high versus low. For instance, presenting research participants with a leading questionnaire (Libby & Eibach, 2002) may prove to be an effective, reactance-free method to experimentally induce high and low levels of ability to achieve closure. Similarly, Kossowska and colleagues (2014) have in recent research induced a sense of (relatively) low ability to achieve closure among participants by having them try to complete unsolvable tasks.

Although cognitive closure is in the first place a cognitive state, in our studies we

also expected closure to be manifested in behavior. We consistently found a significant effect of our manipulation of ability to achieve closure in the predicted direction on cognitive manifestations of closure achieved (i.e., the self-report measure). However, for the behavioral measure of closure achieved (i.e., the binary poll measure) the results were mixed. That is, we found a marginally statistically significant effect of the experimental manipulation in the predicted direction on this measure in Study 3.1, but no such effect in Study 3.2. It is unlikely that this can be explained by a lack of validity of the behavioral measure, since in both studies we found a clear relation between the cognitive and behavioral measure of closure achieved. Our inability to establish a robust effect on the behavioral measure may be explained by the low sensitivity of the binary, fairly crude poll measure that we employed. We can imagine that a more sensitive behavioral measure of cognitive closure (e.g., with a continuous scale of measurement) might reveal a more robust effect of ability to achieve closure on behavioral manifestations of cognitive closure.

Furthermore, it would be interesting to see if achieving cognitive closure not only leads to less openness to additional opinionative information—an *intra*personal consequence—but also to increases people's inclination to propagate their viewpoint among others—an *inter*personal consequence. People often rely on and are influenced by other people's views when forming their attitudes and making up their minds (Crano & Prislin, 2006; Kruglanski et al., 2009). An attitude that is expressed more frequently has, as a consequence, a larger potential impact on others' viewpoints than attitudes that are voiced less often. If it is indeed the case that closed attitudes are more likely to be expressed, the impact of cognitive closure (and ability to achieve closure) in the realm of public opinion is even greater than already known. Exploring these issues would be a useful direction for future research.

Conclusion

We conclude that people's perceptions of their ability to achieve closure are an important antecedent of the extent to which they achieve cognitive closure regarding specific complex topics. In turn, the achievement of cognitive closure reduces people's openness to additional attitude-relevant information that is opinionative in nature. The present research thus contributes to the existing literature on antecedents as well as consequences of the achievement of cognitive closure, and highlights the importance of ability to achieve closure in the realm of attitude formation.

Chapter 4

It Seems Like They Know What They're Talking About: How Perceptions of Source Expertise Affect the Ability to Achieve Cognitive Closure

This chapter is based on Koot, C., Ter Mors, E., Ellemers, N., & Daamen, D. D. L. (2014c). *Facilitation of attitude formation through communication: How perceived source expertise enhances the ability to achieve cognitive closure about complex environmental topics*. Manuscript submitted for publication.

Closed attitudes—attitudes about which people have achieved a state of cognitive closure—are known to be more stable and predictive of actual behavior than "unfinished" or open attitudes (cf. Bassili, 1996; Fazio & Zanna, 1978; Krosnick & Petty, 1995; Petty & Cacioppo, 1986b). As a consequence, such closed, definite attitudes are also more predictive of people's support for or opposition to policies, projects, or other enterprises that affect them or are otherwise relevant to them. For example, people's current attitudes on nuclear energy are more indicative of their future support for a government's plan to increase the production of nuclear energy if the attitudes are closed, compared to when they are unfinished and open. It is hence important to understand the factors that lead people to achieve a state of cognitive closure. The present research investigates how one such antecedent of cognitive closure—the ability to achieve closure—is determined in the context of information provision about a complex, publicly relevant topic. We examine the importance of the level of expertise that people ascribe to a source of information for their ability to achieve cognitive closure on a complex topic. Specifically, we will examine whether and how the identity of a source and the communication of consensus influence people's perceptions of source expertise, and as such impact on the ability to achieve closure.

The Ability to Achieve Cognitive Closure

Research on precursors of cognitive closure has so far primarily focused on people's *need* for closure (e.g., Kruglanski et al., 2009; Kruglanski & Webster, 1996; Webster & Kruglanski, 1994, 1997). This research has uncovered that people tend to differ from each other in the extent to which they feel compelled to reach and maintain a state of closure, or are comfortable to retain a more open, undecided view of different issues. More recent work, however, has also started paying attention to the idea that people differ in their *ability* to achieve cognitive closure, i.e., whether they manage to make up their mind and decide what they think, or feel unable to do so (e.g., Kossowska & Bar-Tal, 2013; Roets & Soetens, 2010; Roets & Van Hiel, 2007).

In our prior research we demonstrated that the extent to which people feel able to achieve closure is an important antecedent of the actual achievement of cognitive closure in the context of complex topics (Koot, Ter Mors, Ellemers, & Daamen, 2014a). In this work, we define the ability to achieve closure as the perceived ability to make judgments and decisions confidently and with certainty (cf. Roets & Van Hiel, 2007). We developed an experimental procedure to manipulate the extent to which participants believed they were able to achieve closure. In two experimental studies using this manipulation, participants were invited to form an attitude on the complex, environmental topic of carbon capture and storage technology (CCS). Participants who were led to believe

that their ability to achieve closure was relatively high actually achieved more cognitive closure in their attitudes towards CCS—as indicated in a self-report measure as well as a behavioral measure (taking a stance in an opinion poll). This research thus revealed that people's ability to achieve closure influences the level of cognitive closure that they achieve and demonstrated that the extent to which people feel able to achieve closure can also be determined by external factors, instead of representing a stable individual difference factor (see also Kossowska et al., 2014). Only a few studies so far have manipulated the ability to achieve closure, and have done so by employing relatively artificial experimental procedures. Now that it has been established that external factors in principle can affect whether or not people feel capable of making up their mind, the next question is which factors tend to have such effects in daily life. In the case of decision making about complex topics, a pertinent complication when trying to form one's opinion is that multiple parties are available to provide potentially relevant information. In judging the value of such information, we know that people tend to refer to source characteristics as useful cues (e.g., Bohner, & Dickel, 2011). In the present research, we examine whether the perceived expertise of an information source relates to people's ability to form a closed attitude on complex topics.

Perceived Source Expertise and the Ability to Achieve Closure

The public discourse in today's society is increasingly characterized by highly complex issues, such as international political conflicts and the threat of climate change. Due to the complex nature of such topics, many people will feel incapable of forming a definite attitude about them, or of achieving cognitive closure. In order to advance the attitude formation process, people can consult information on the topic in question. However, given the extensive supply of information that is available these days, not all information will be equally helpful for the formation of a closed attitude. In this study we propose that people feel particularly strengthened in their ability to make up their mind about complex issues when they believe that they are consulting or receiving information from a *knowledgeable* source. That is, people should feel more comfortable forming their attitude on the basis of information from a source that they believe to be an expert, rather than a lay source. Prior research (for instance in product marketing) has shown that identical information seems more *convincing* when originating from a source that is regarded as having high expertise, compared to low expertise (e.g., Cialdini & Goldstein, 2004; Pornpitakpan, 2004). That is, persuasive communication has a greater impact on the *content* of people's attitudes when they believe that information is provided by a highly knowledgeable source versus an uninformed source. We build

on this prior research to examine whether a parallel effect of perceived source expertise can be observed for the *confidence* people have in their ability to achieve closure. We propose that people feel better able to achieve cognitive closure on the basis of a piece of information when they perceive the information source to have high, rather than low, relevant expertise.

Source Identity and Consensus as Cues of Source Expertise

If perceived source expertise is indeed important for people's ability to achieve closure, then this raises the question of what determines people's impressions of source expertise. In the present research, we propose two determinants of perceptions of source expertise, namely *who* is providing the information (source identity) and what *message* is being communicated (consensus vs. non-consensus).

To start with the importance of *who* is providing the information; we argue that people may consider the identity of an information source to gain a sense of its expertise. That is, when different individuals or stakeholders provide information, merely knowing who they are or which body they represent can already provide an indication of the source's knowledgeability (e.g., Reimer et al., 2004). For instance, knowing whether a statement is made by a random person in the street, a relevant professional, or a journalist already indicates the likelihood that this source has relevant expertise about the topic in question. Which of these parties is most likely to offer expert information further depends on the issue under consideration. When receiving information on the effectiveness of vaccinations for instance, knowing that this information was provided by a professor of immunology will lead people to infer high source expertise, as an academic title in a relevant field suggests that years of high-level education, training, and professional experience are contained in the information provided. This is less likely to be the case, however, when another parent in the playground proclaims his or her beliefs about potential side effects of immunization, as this most probably reflects idiosyncratic views, very limited case observations or unwarranted hearsay. We therefore predict that relevant features indicating the identity of an information source determine people's perceptions of the source's expertise. Furthermore, we predict that when people attribute high expertise to a source on the basis of its identity, this should lead them to feel better able to achieve closure compared to when they believe the source to have low relevant expertise.

Second, we argue that for perceptions of source expertise it may not only matter who provides the information, but that it is also important what message the information source communicates. Prior research has tended to consider sources of information either as being represented by a particular individual, or as a unified entity, representing

a single particular stance or opinion. In real life, however, a source of information is more likely to constitute of a collection of individuals, or group of relevant stakeholders, such as professionals, citizens, politicians, or businesses. Moreover, in particular in the case of complex and multi-faceted topics, it is not self-evident that all individuals who together constitute a particular information source are in full agreement with each other, or focus on the same information aspects. As a result, when such sources provide information about complex topics, they do not always draw definite conclusions about the issue at stake. They may, for instance, indicate concern about current developments without providing explicit guidelines about what should be done instead. For example, an organization involved with the fight against global warming can provide information about different technologies that have been developed to reduce greenhouse gas emissions, while explaining that there are conflicting views on which of these technologies can be best employed. In view of our current research interest, the question is how such (lack of) consensus affects the perceived expertise of the source in question among those receiving such information, and how such a message as a consequence affects their ability to achieve closure on the topic. In highly complex situations, even experts do not necessarily agree about each aspect of the issue in question and lack of consensus may simply reflect a very careful and nuanced consideration of the complex nature of the topic. However, we anticipate that communicating disagreement about relevant concerns or conclusions will generally tend to be interpreted as a sign of low expertise—for instance when this disagreement is seen to reveal that not everyone is equally aware of relevant facts. If this is the case, an information source that expresses consensus about a complex topic might more easily evoke the impression that individuals draw on a common and objective knowledge base and that they "know what they are talking about". Expressions of consensus may thus be taken as a proxy of high source expertise. We therefore predict that people perceive higher source expertise when an information source communicates consensus rather than non-consensus. Furthermore we predict that when people attribute high expertise to a source that communicates consensus, this should lead them to feel better able to achieve closure compared to when an information source communicates disagreement—resulting in a reduction of perceived expertise. Thus, we argue that perceptions of source expertise do not only depend on the identity of the source or its objective level of expertise, but is also likely to vary depending on the content of the source's communication.

Finally, in examining the impact of source identity as well as level of consensus communicated, we will explore the possibility that the impact of communicating (non-)consensus on perceived expertise also depends on the identity of the source. We anticipate that there is relatively little added value in communicating consensus

when high expertise is already clearly implied in the identity of the source. Thus, communication of consensus might particularly increase the perceived expertise of a source (and increase people's ability to achieve closure) whose expertise seems to be low on the basis of its identity. For instance, when private citizens who have no particular knowledgeability on climate change all agree that in their garden plants come into bloom earlier every year, this may suggest some shared expertise based on lay observations, even if their observations are inaccurate or remain unverified.

The Present Research

We examine the importance of perceptions of source expertise for people's ability to achieve cognitive closure about complex topics in two experimental studies. Specifically, we assess whether and how the identity of the information source and the communication of (non-)consensus affect perceived source expertise. Moreover, we investigate how these effects on perceptions of source expertise in turn influence people's ability to achieve closure. The studies will be conducted in the context of the complex environmental topic of carbon capture and storage technology (CCS); a climate change mitigation technology that is considered important for stabilizing greenhouse gas concentrations in the atmosphere (IPCC, 2007)[10]. In both studies, the identity of the information source is manipulated by explaining to participants that they are to receive information on CCS from either the "Association of Citizens and Sustainability" or the "Association of Dutch Geophysicists and Sustainability". In Study 4.2, we additionally manipulate source consensus by explaining that the members of the information source either agree or disagree among themselves regarding the consequences of CCS for the environment. The level of source expertise that participants perceive and the extent to which they feel able to achieve closure are measured in both studies as central outcome variables. Additionally, in Study 4.2, participants are actually provided with information on CCS that allegedly originates from the information source and in which consensus or non-consensus is communicated. In this study we then also measure the extent to which participants achieve cognitive closure in their attitude formation towards the implementation of CCS with both a self-report and a behavioral measure. We test the following hypotheses:

H1. We argue that people will perceive an association of relevant professionals to have higher expertise on CCS than an association of citizens, and that this higher level of perceived expertise in turn increases people's ability to achieve closure on the complex

10 CCS involves the capture of CO2 produced in power plants or other industrial sources, transportation of the CO2 to underground storage sites (e.g., depleted oil and gas fields), and long-term storage in these sites. As with other complex technologies, public acceptance is a critical factor in the successful implementation of CCS (e.g., Markusson et al., 2011; Terwel et al., 2012).

topic of CCS. As a result, we predict that source identity will indirectly influence ability to achieve closure through perceived source expertise.

H2. We argue that people will perceive an information source that communicates consensus to have higher expertise than a source that communicates non-consensus, and that this higher level of perceived expertise in turn increases people's ability to achieve closure on the complex topic of CCS. We thus predict that source consensus will indirectly influence ability to achieve closure through perceived source expertise.

Additionally, we will explore whether or not the indirect effect of consensus on ability to achieve closure, as predicted in Hypothesis 2, applies equally to both types of sources examined (relevant professionals vs. citizens). We anticipate that the added value of consensus as an indicator of expertise may be particularly evident in the case of a lay source (citizens).

Study 4.1

The aim of Study 4.1 was to test our prediction that the identity of an information source affects perceptions of source expertise, and in this way indirectly influences people's ability to achieve closure on a complex topic (Hypothesis 1). Initial support for this hypothesis was found in a preliminary study that was set up, among other things, to explore the effects of source identity on perceived source expertise and ability to achieve closure. In this preliminary study we used a similar setup and an identical source identity manipulation as in Study 4.1, but were unable to achieve random allocation to conditions because data for the two source identity conditions were collected separately and several months apart from each other. Nevertheless, data from this preliminary study revealed that university students ($N = 89$) perceived higher levels of source expertise ($\alpha = .92$, $F[1, 87] = 23.31$, $p < .001$, $\eta_p^2 = .21$) and perceived themselves to be better able to achieve closure on CCS ($\alpha = .68$, $F[1, 87] = 7.53$, $p = .007$, $\eta_p^2 = .08$) when anticipating to receive information from Geophysicists than from the Citizens Association. Further, perceived source expertise was found to mediate the effect of source identity on ability to achieve closure in this sample (indirect effect $B = 0.23$, 95% CI [0.06, 0.49]; c' path $B = 0.28$, $p = .175$). These data provide initial support for Hypothesis 1, and for the effectiveness of the source identity manipulation and experimental procedure we developed to examine this. In Study 4.1, we sought to test the robustness of these findings under more controlled circumstances.

Method

Participants and design

Seventy social science and humanities undergraduate students (19 men and 51 women, M_{age} = 20.90, SD = 3.58) from Leiden University participated in this experimental study and were randomly assigned to either one of the source identity conditions (the Citizens Association condition or the Geophysicists condition). Participants received a monetary reward or course credit in return for their participation.

Procedure

The study was the first in a series of unrelated studies. Upon arrival at the laboratory, participants were led to individual cubicles, each containing a PC on which the study would be conducted. Participants first read an introductory text on climate change and carbon dioxide capture and storage technology (CCS). They then learned that CCS would possibly be implemented in the west of the Netherlands, which is the region where the participants lived, or to which they were tied in other ways, and where Leiden University is located. The study was introduced as a study on the attitudes of inhabitants of the west of the Netherlands towards the potential implementation of CCS in this region. Next, participants were told that before they were to report their attitudes on the implementation of CCS, they would receive more information on the topic. Participants learned that there are various bodies and organizations that provide information on CCS and that they would receive information from one of these sources. They also learned that not every participant would receive information from the same source and that some information sources might appeal more than others. As a manipulation of source identity, participants were either told that they would receive information from "the Association of Citizens and Sustainability" or that they would receive information from "the Association of Dutch Geophysicists and Sustainability". Both these information sources were fictitious.

Participants in the Citizens Association condition read:

> In your case the information about carbon capture and storage technology and its implementation in the west of the Netherlands is coming from the Association of Citizens and Sustainability. This association is concerned with developments regarding sustainability and consists of Dutch citizens: These are people with diverse backgrounds who are interested in the topic. The Association of Citizens and Sustainability has listed information about aspects and characteristics of carbon capture and storage technology in the west of the Netherlands that in their view are the most important.

Participants in the Geophysicists condition, on the other hand, read:

> In your case the information about carbon capture and storage technology and its implementation in the west of the Netherlands is coming from the Association of Dutch Geophysicists and Sustainability. This association is concerned with developments regarding sustainability and consists of geophysicists: These are experts who are specialized in the topic. The Association of Dutch Geophysicists and Sustainability has listed information about aspects and characteristics of carbon capture and storage technology in the west of the Netherlands that in their view are the most important.

Participants then completed the manipulation check of the source identity manipulation and completed measures of perceived source expertise and ability to achieve closure. At the end of the series of studies in which the participants took part, participants were thanked and debriefed. They also learned that they would not receive additional information on CCS.

Measures

Depending on experimental condition, participants either answered questions relating to (information from) the Association of Citizens and Sustainability or relating to (information from) the Association of Dutch Geophysicists and Sustainability. For reasons of legibility, we refer to both associations using the term "*the information source*" in our presentation of the dependent variables below.

Manipulation check. To check whether participants had correctly understood the identity of the information source, they were asked the following question: "Is the information that you are about to read about carbon capture and storage technology provided by *the information source*?" (1 = *yes*; 2 = *no*).

Perceived source expertise. The level of expertise that the participants ascribed to the information source was measured using a 4-item questionnaire. Participants were asked to indicate their agreement with the following statements: "I think that the members of *the information source* know a lot about carbon capture and storage technology", "I think that the members of *the information source* are knowledgeable about carbon capture and storage technology", "I think that *the information source* is a specialist in the area of carbon capture and storage technology", and "I think that *the information source* has expertise in the area of carbon capture and storage technology" (1 = *completely disagree*, 7 = *completely agree*). A perceived source expertise scale was calculated by averaging participants' responses to the items ($\alpha = .93$).

Ability to achieve closure. Participants' perception regarding their ability to achieve closure on CCS was measured by means of a 4-item questionnaire. Participants

were asked to indicate their agreement with the following statements: "I think that I can form a clear opinion on the implementation of carbon capture and storage technology in the west of the Netherlands on the basis of the information of *the information source*", "I expect that after reading the information of *the information source* I will be certain of my opinion on the implementation of carbon capture and storage technology in the west of the Netherlands", "I expect that after reading the information of *the information source* my opinion on the implementation of carbon capture and storage technology in the west of the Netherlands will be fixed", and "I think that after reading the information of *the information source* I will still have a need for extra information about carbon capture and storage technology" (reverse-coded) (1 = *completely disagree*, 7 = *completely agree*). An ability to achieve closure score was calculated by averaging participants' responses to the items (α = .66).

Results

Manipulation check

We screened the data for incorrect answers to the manipulation check. Two of the 70 participants had incorrectly understood the identity of the information source. We excluded these cases from the analyses reported below; accordingly, the analyses reported below were performed on the data of 68 participants. Inclusion of all cases did not change the pattern of results.

Perceived source expertise

Analysis of variance (ANOVA) showed a significant effect of source identity on perceived source expertise, $F(1, 66) = 57.75$, $p < .001$, $\eta_p^2 = .47$. As predicted, and consistent with the results of the preliminary study, participants in the Geophysicists condition ascribed higher levels of expertise to the information source ($M = 5.66$, $SD = 0.62$) compared to participants in the Citizens Association condition ($M = 3.89$, $SD = 1.21$).

Ability to achieve closure

ANOVA revealed a marginally significant effect of source identity on ability to achieve closure in the predicted direction, $F(1, 66) = 3.07$, $p = .085$, $\eta_p^2 = .04$. That is—replicating the results of our preliminary study—participants in the Geophysicists condition felt better able to achieve closure in their attitudes on CCS ($M = 3.61$, $SD = 0.92$) compared to participants in the Citizens Association condition ($M = 3.21$, $SD = 0.95$).

Mediation analysis

We followed a bootstrapping procedure (Preacher & Hayes, 2008: 5000 resamples, bias corrected) to examine whether or not perceived source expertise mediated the effect of source identity on ability to achieve closure. The results indeed revealed a significant indirect effect of the source identity manipulation (0 = Citizens Association, 1 = Geophysicists) on ability to achieve closure through perceived source expertise (B = 0.65, 95% CI [0.31, 1.11]; c' path B = –0.24, p = .411), thereby providing additional support for Hypothesis 1.

Discussion

Results of Study 4.1 provide support for our argument that when people believe an information source to have high expertise, they consider themselves to be more capable of forming a closed attitude than when they perceive the source to have low expertise on the topic in question. Specifically, we found that level of expertise that participants ascribed to the information depended on the identity of the source, and that perceived expertise in turn affected people's ability to achieve closure. Providing support for Hypothesis 1, and consistent with the results of the preliminary study, participants perceived the Geophysicists to have higher relevant expertise than the Citizens Association, and as a consequence, participants felt better able to achieve closure on CCS when anticipating information from the Geophysicists.

Study 4.2

The goals of Study 4.2 were the following; First, we set out to replicate the results of Study 4.1 on the indirect effect of source identity on ability to achieve closure through perceived source expertise (Hypothesis 1). The second goal was to extend these results by examining our further prediction that the communication of consensus (versus non-consensus) by an information source increases people's perceptions of source expertise and in this way enhances their ability to achieve closure (Hypothesis 2). Finally, we explored whether or not the indirect effect of consensus on ability to achieve closure through perceived source expertise, as predicted in Hypothesis 2, applies regardless of the base rate level of source expertise implied in its identity (i.e., the Citizens Association and the Geophysicists).

The design of Study 4.2 was similar to the design of Study 4.1. As in the previous study, we varied the identity of the information source from which participants expected to receive information on carbon capture and storage technology (CCS); the Association of Citizens and Sustainability versus the Association of Dutch Geophysicists

and Sustainability. In the present study, we also varied the level of consensus in the source, in a 2 × 2 design. That is, participants additionally learned that there was agreement or disagreement among members of the information source regarding the consequences of CCS for the environment. Participants then completed the central outcome measures of perceived source expertise and ability to achieve closure. Next, in another extension of Study 4.1, participants actually received information on CCS that ostensibly originated from the information source and in which consensus or non-consensus was communicated. After participants had read this information, we measured the extent to which they actually achieved cognitive closure in their attitude towards the implementation of CCS. We know from our own previous research (Koot et al., 2014a) that ability to achieve closure affects the level of cognitive closure that people achieve in their actual attitude formation. Hence, we anticipated that the source identity manipulation and the consensus manipulation would not only affect (self-perceived) ability to achieve closure, but also in a similar way would influence the level of closure that participants actually achieved when attempting to form an opinion about the topic. Finally, in extension of Study 4.1 we included control measures in the present study to rule out a number of potential alternative explanations for the observed patterns. Specifically, we checked whether individual differences in general need to achieve closure (Webster & Kruglanski, 1994) or in overall self-efficacy (Bandura, 1977, 2006) were related to differences we observed between research participants in their ability to achieve cognitive closure.

Method

Participants and design

Eighty-six social science and humanities undergraduate students (22 men and 64 women, M_{age} = 20.76) from Leiden University participated in Study 4.2 and were randomly assigned to one of the conditions of the 2 (source identity: Citizens Association vs. Geophysicists) × 2 (consensus: consensus vs. non-consensus) between-participants factorial design. Participants received a monetary reward or course credit in return for their participation.

Procedure

Study 4.2 was the first in a series of unrelated studies. The study followed the same procedure as Study 4.1 up to the point where the source identity manipulation was introduced. The source identity manipulation—Citizens Association versus Geophysicists—was identical to the manipulation in Study 4.1. However, instead of the last sentence of the manipulation ("*The information source* has listed information about

aspects and characteristics of carbon capture and storage technology in the west of the Netherlands that in their view are the most important."), the consensus manipulation was introduced. Depending on experimental condition, participants read (manipulated information in italics):

> *The Association of Citizens and Sustainability/the Association of Dutch Geophysicists and Sustainability* has listed what in their view are the most important consequences of carbon capture and storage technology for the environment. You are about to read this information. It is good to know that the members of *the Association of Citizens and Sustainability/ the Association of Dutch Geophysicists and Sustainability agree/disagree* among themselves about the net effect of carbon capture and storage technology for the environment. In other words; the members *all draw the same conclusion/do not all draw the same conclusion.* This also appears from the information of *the Association of Citizens and Sustainability/the Association of Dutch Geophysicists and Sustainability*.

Participants then completed manipulation checks of source identity and consensus and they completed measures of the central outcome variables of perceived source expertise and ability to achieve closure. Next, in extension of Study 4.1, participants read information on CCS that allegedly originated from the announced source (Citizens Association or Geophysicists) and in which (non-)consensus was expressed. In all experimental conditions, the information from the source consisted of the same two arguments that were based on the CCS argument map by Van Egmond and Hekkert (2012); one argument reasoning why the effects of CCS for the environment would be positive and one argument reasoning why the effects would be negative. In the consensus condition, members of the source agreed on the net effect of CCS for the environment. The conclusion of the source on this topic was counterbalanced (i.e., an overall positive effect of CCS for the environment or an overall negative effect). Half of the participants in the consensus condition read (manipulated information in italics):

> The members of *the Association of Citizens and Sustainability/the Association of Dutch Geophysicists and Sustainability* agree among themselves about the net effect of carbon capture and storage technology for the environment. This is what they have to say about it: "The members of our association think that the effect of carbon capture and storage technology for the environment is positive, since the technology reduces CO_2 emissions and thereby fights climate change. Indeed, large amounts of chemical waste are produced with the capture of CO_2 but according to our members this does not outweigh the advantage of fighting climate change."

The other half of the participants in the consensus condition read (manipulated information in italics):

> The members of *the Association of Citizens and Sustainability/the Association of Dutch Geophysicists and Sustainability* agree among themselves about the net effect of carbon capture and storage technology for the environment. This is what they have to say about it:"The members of our association think that the effect of carbon capture and storage technology for the environment is negative, since large amounts of chemical waste are produced with the capture of CO_2. Indeed, carbon capture and storage technology reduces CO_2 emissions and thereby fights climate change, but according to our members this does not outweigh the disadvantage of chemical waste."

In the non-consensus condition, on the other hand, members of the source disagreed on the net effect of CCS for the environment. The same two arguments as in the consensus condition were used, and the order in which they were presented was counterbalanced. Half of the participants in the non-consensus condition read (manipulated information in italics):

> The members of *the Association of Citizens and Sustainability/the Association of Dutch Geophysicists and Sustainability* disagree among themselves about the net effect of carbon capture and storage technology for the environment. This is what they have to say about it: "Some members of our association think that the effect of carbon capture and storage technology for the environment is positive, since the technology reduces CO_2 emissions and thereby fights climate change. Others find that this advantage does not outweigh an important disadvantage—being that large amounts of chemical waste are produced with the capture of CO_2. They think that the effect of carbon capture and storage technology for the environment is negative."

The other half of the participants in the non-consensus condition read (manipulated information in italics):

> The members of *the Association of Citizens and Sustainability/the Association of Dutch Geophysicists and Sustainability* disagree among themselves about the net effect of carbon capture and storage technology for the environment. This is what they have to say about it: "Some members of our association think that the effect of carbon capture and storage technology for the environment is negative, since large amounts of chemical waste are produced with the capture of CO_2. Others find that this disadvantage does not outweigh an important advantage—being that the technology reduces CO_2 emissions and thereby fights climate change. They think that the effect of carbon capture and storage technology for the environment is positive."

After reading the information on CCS, participants indicated their attitude toward the implementation of CCS in the west of the Netherlands[11] (1 = *very negative*, 7 = *very positive*; overall $M = 3.80$, $SD = 1.05$) and completed a cognitive (self-report) measure and behavioral measure of cognitive closure achieved concerning the topic of CCS, an additional manipulation check of source consensus, and a number of control measures.[12] At the end of the series of studies in which the participants took part, they were thanked and debriefed.

Measures

Manipulation checks. We employed the same source identity manipulation check as in Study 4.1 to check whether participants had understood the source identity manipulation correctly. To check whether participants had understood the consensus manipulation correctly, prior to reading the information from the information source they were asked to indicate whether members of the information source agree or disagree among themselves concerning the net effect of the implementation of carbon capture and storage technology for the environment (1 = *they disagree among themselves*; 2 = *they agree among themselves*). Moreover, at the end of the study—that is, after reading the information ostensibly provided by the source in question and completing the measures of cognitive closure achieved—participants were asked to indicate the *extent* to which they thought that the members of the information source disagreed or agreed among each other about the net effect of carbon capture and storage technology for the environment (1 = *disagreed completely*, 7 = *agreed completely*).

Control measures. We wanted to rule out the possibility that effects of our experimental manipulations might be accounted for by individual differences between participants in their overall need for closure or self-efficacy (c.f. Webster & Kruglanski, 1994). We therefore assessed these two factors as control variables after completing the actual study, presenting these measures to participants as an unrelated study on personality differences. We measured need for closure using the revised 15-item need for closure scale developed by Roets and Van Hiel (2011) ($\alpha = .80$). Self-efficacy was measured by means of the Dutch adaptation of the general self-efficacy scale (Teeuw et al., 1994), which consists of 10 items ($\alpha = .81$). Higher scores on the 7-point scales indicate higher levels of need for closure or higher levels of self-efficacy.

Perceived source expertise. Perceived source expertise was measured using the

11 There were no significant main effects of, or interaction effect between the source identity manipulation and the consensus manipulation on participants' (positive or negative) attitudes towards the implementation of CCS in the west of the Netherlands, $Fs(1, 72) \leq 1.63$, $ps \geq .205$.

12 We checked whether counterbalancing of the source's message (positive versus negative conclusions in the consensus condition; order of arguments in the non-consensus condition) significantly affected cognitive closure achieved. This was not the case.

same items as in Study 4.1 (α = .93).

Ability to achieve closure. Ability to achieve closure was measured with the same items as in Study 4.1 (α = .84).

Cognitive closure achieved. Following the attitude measure, participants' cognitive closure regarding their attitude on CCS was measured using a cognitive (self-report) measure as well as a behavioral measure, which were both virtually identical to those used in our previous research on cognitive closure (Koot et al., 2014a). First, participants indicated their agreement with 13 statements regarding their attitude on the implementation of CCS, such as "I am certain of my opinion on the implementation of carbon capture and storage technology in the west of the Netherlands", "I feel undecided about my opinion on carbon capture and storage technology" (reverse-coded), and "My opinion on the implementation of carbon capture and storage technology in the west of the Netherlands is fixed" (1 = *completely disagree*, 7 = *completely agree*). A cognitive closure scale was calculated by averaging participants' responses to the items (α = .81), on which higher scores indicate higher levels of cognitive closure achieved.

We then assessed cognitive closure achieved with a behavioral measure, which involved asking participants to decide whether or not they were ready to participate in a poll concerning the implementation of CCS in the west of the Netherlands (1 = *I am ready to participate*; 2 = *I am not yet ready to participate*). The results of this poll would ostensibly be forwarded to governmental organizations involved in the implementation of CCS in the west of the Netherlands. After indicating whether or not they were ready to participate, participants who answered affirmatively could choose to vote for or against the implementation of CCS. Participants' decision whether or not to participate in the poll (i.e., commit to their attitude) was used as a behavioral measure of cognitive closure achieved, in which the decision to participate in the poll was regarded an indicator of cognitive closure.

Results

Descriptive statistics (means, standard deviations, and percentages) for the dependent variables as a function of source identity and consensus are presented in Table 4.1.

Table 4.1.

Means (Standard Deviations) and Percentages of Perceived Source Expertise, Ability to Achieve Closure, and Cognitive Closure Achieved as a Function of Source Identity and Consensus (Study 4.2)

	Source identity			
	Citizens Association		Geophysicists	
	Consensus	Non-consensus	Consensus	Non-consensus
Perceived source expertise	4.28 (1.29)	3.56 (1.07)	5.66 (0.72)	5.33 (0.85)
Ability to achieve closure	3.40 (1.16)	2.56 (1.00)	3.50 (1.19)	3.45 (0.90)
Cognitive closure achieved				
Self-report	3.90 (0.81)	2.90 (0.60)	3.27 (0.79)	3.25 (0.64)
Readiness to participate in poll	64%	17%	47%	37%

Manipulation checks

We screened the data for incorrect answers to the factual manipulation checks of source identity and consensus (i.e., the checks that took place prior to reading the information on CCS from the information source). Ten participants answered one of the manipulation check questions incorrectly. This means that these participants had incorrectly understood the identity of the information source or had incorrectly understood that the members of the information source (dis)agreed among themselves (none of the participants answered both questions incorrectly). We excluded these cases from the analyses below. Thus, the analyses reported below were conducted on the data of 76 participants. Inclusion of all cases did not change the pattern of results.

Analysis of Variance (ANOVA) on the remaining participants' perceptions of the level of (dis)agreement among members of the information source (assessed after completion of the study) further confirmed that participants in the consensus condition clearly perceived higher consensus among source members ($M = 6.23$, $SD = 1.56$) than participants in the non-consensus condition ($M = 2.54$, $SD = 1.61$), $F(1, 72) = 98.68$, $p < .001$, $\eta_p^2 = .58$. There was no main effect of source identity on this measure, $F(1, 72) < 1$, $p = .757$, nor an interaction between source identity and consensus, $F(1, 72) < 1$, $p = .818$, confirming that we were able to manipulate perceived source consensus independently from source identity.

Control measures

ANOVAs showed no significant main effects of, or interaction effect between

source identity and consensus on need for closure or on self-efficacy, Fs(1, 72) ≤ 1.80, ps ≥ .184. Furthermore, including need for closure and self-efficacy as covariates in subsequent analyses did not change the pattern of results reported below. Thus, effects of our experimental manipulations on participants' responses cannot be ascribed to differences between conditions in need for closure or self-efficacy.

Perceived source expertise

We conducted a 2 × 2 ANOVA with source identity and consensus as independent variables and perceived source expertise as the dependent variable. As in Study 4.1, and as predicted in Hypothesis 1, results showed a significant main effect of source identity, $F(1, 72) = 44.43$, $p < .001$, $\eta_p^2 = .38$, where participants in the Geophysicists condition ascribed higher levels of expertise to the information source ($M = 5.49$, $SD = 0.80$) than participants in the Citizens Association condition ($M = 3.96$, $SD = 1.24$). The analysis further revealed the predicted main effect of consensus, $F(1, 72) = 5.04$, $p = .028$, $\eta_p^2 = .07$, where participants in the consensus condition perceived significantly higher levels of source expertise ($M = 4.88$, $SD = 1.27$) compared to those in the non-consensus condition ($M = 4.47$, $SD = 1.31$). There was no significant interaction effect of source identity and consensus on perceived source expertise, $F(1, 72) < 1$, $p = .405$.

Ability to achieve closure

We submitted participants' perceptions concerning their ability to achieve closure on CCS to a 2 × 2 ANOVA with source identity and consensus as independent variables. Consistent with our prediction (Hypothesis 1), and replicating the results of Study 4.1, the analysis revealed a significant main effect of source identity, $F(1, 72) = 4.08$, $p = .047$, $\eta_p^2 = .05$, such that participants in the Geophysicists condition felt better able to form a closed attitude on CCS ($M = 3.47$, $SD = 1.03$) than participants in the Citizens Association condition ($M = 3.02$, $SD = 1.15$). Furthermore, the analysis revealed a marginally significant main effect of consensus on ability to achieve closure, with the pattern of means revealing differences in the predicted direction (Hypothesis 2), $F(1, 72) = 3.30$, $p = .073$, $\eta_p^2 = .04$. That is, participants in the consensus condition felt (marginally) better able to form a closed attitude on CCS ($M = 3.44$, $SD = 1.16$) than participants in the non-consensus condition ($M = 3.01$, $SD = 1.04$). There was no significant interaction effect between source identity and consensus on ability to achieve closure, $F(1, 72) = 2.57$, $p = .113$.

Mediation analyses

We followed a bootstrapping procedure (Preacher & Hayes, 2008: 5000 resamples, bias corrected, controlling for consensus) to test our prediction that perceived source expertise would mediate the effect of source identity on ability to achieve closure.

Consistent with Hypothesis 1 and corroborating the results of Study 4.1, the analysis showed a significant indirect effect of the source identity manipulation (0 =Geophysicists, 1 = Citizens Association) on ability to achieve closure through perceived source expertise, $B = -0.70$, 95% CI (−1.08, −0.38); c' path $B = 0.21$, $p = .464$. This means that to the extent that people perceive an association of Geophysicists to have higher expertise on CCS than a Citizens' association, this higher level of source expertise in turn increases their ability to achieve closure on CCS.

We followed another bootstrapping procedure (Preacher & Hayes, 2008: 5000 resamples, bias corrected, controlling for source identity) to test our second hypothesis that perceived source expertise would also mediate the effect of consensus on ability to achieve closure. Results confirmed our prediction and revealed a significant indirect effect of the consensus manipulation (0 = consensus, 1 = non-consensus) on ability to achieve closure through perceived source expertise, $B = -0.24$, 95% CI (−0.51, −0.05); c' path $B = -0.23$, $p = .340$, thereby providing support for Hypothesis 2. That is, these results show that to the extent that the communication of consensus (versus non-consensus) increases people's perceptions of source expertise, this higher level of source expertise in turn increases people's ability to achieve closure on CCS.

Cognitive closure achieved

To test whether the source identity manipulation and consensus manipulation also affected the level of cognitive closure that participants actually achieved, we first conducted a 2 × 2 ANOVA on the self-report measure of closure achieved. Results of the analysis revealed no main effect of source identity, $F(1, 72) < 1$, $p = .397$, but did reveal a significant main effect of consensus, $F(1, 72) = 9.35$, $p = .003$, $\eta_p^2 = .11$. This main effect was qualified by a significant interaction between source identity and consensus, $F(1, 72) = 8.77$, $p = .004$, $\eta_p^2 = .11$. Additional analyses of simple main effects revealed that in the case of the Citizens Association, participants reported significantly higher levels of cognitive closure achieved when members of the source had communicated consensus ($M = 3.90$, $SD = 0.81$) compared to when they had communicated disagreement (i.e., non-consensus) ($M = 2.90$, $SD = 0.60$), $B = 1.00$, $t = 4.36$, $p < .001$. In the case of the Geophysicists, however, the communication of consensus versus non-consensus did not further increase the level of cognitive closure that participants achieved ($M = 3.27$, $SD = 0.79$, and $M = 3.25$, $SD = 0.64$, respectively), $B = 0.02$, $t = 0.07$, $p = .947$.

We also tested whether source identity and consensus affected the behavioral manifestation of cognitive closure achieved by conducting a 2 × 2 binary logistic regression analysis on participants' decision to participate in the poll, as a way to assess

cognitive closure achieved. Results of the analysis revealed no main effect of source identity ($B = -1.07$, Wald[1] = 1.83, $p = .176$), but did show a main effect of consensus ($B = -2.17$, Wald[1] = 7.89, $p = .005$). In line with the self-report measure of cognitive closure achieved, this main effect was qualified by a marginally significant interaction effect of source identity and consensus ($B = 1.75$, Wald[1] = 2.89, $p = .089$). Separate chi-squared tests for the two source identity conditions revealed that in the Citizens Association condition, participants were more likely to participate in the poll when the source had communicated consensus (64% decided to cast a vote) compared to non-consensus (17% decided to cast a vote), $\chi^2(1) = 8.94$, $p = .003$. In the Geophysicists condition, on the other hand, communication of (non-)consensus did not affect participants readiness to participate in the poll; 47% of participants in the consensus condition decided to cast a vote versus 37% in the non-consensus condition, $\chi^2(1) = 0.39$, $p = .535$.

Additional analyses

At first sight, it may seem inconsistent that we find two main effects on perceived expertise and ability to achieve closure (as predicted), while our measures of cognitive closure achieved reveal an interaction between these two manipulations. We conducted some additional analyses to better understand this apparent discrepancy between our observations on different measures. The ANOVAs we conducted to examine support for our predicted effects on perceived source expertise and ability to achieve closure did not reveal statistically significant interaction effects of source identity and consensus. However, further inspection of the mean scores (see Table 4.1) does suggest that that the effect of consensus on these measures primarily emerged in the Citizens Association condition—reflecting a pattern similar to what we observed in the two measures of closure achieved. We further explored this possibility by conducting separate ANOVAs to examine the effect of the consensus manipulation on perceived source expertise and ability to achieve closure for each of the two source identity conditions. The results of these additional analyses confirm that the added value of communicating consensus for perceived source expertise and ability to achieve closure primarily emerges when the expertise of the source is not clearly implied in its identity. That is, participants who anticipated to receive information from the Citizens Association perceived (marginally) higher levels of source expertise and felt significantly better able to achieve closure on CCS when this source communicated consensus ($M_{expertise} = 4.28$, $SD_{expertise} = 1.29$; $M_{ability} = 3.40$, $SD_{ability} = 1.16$) compared to non-consensus ($M_{expertise} = 3.56$, $SD_{expertise} = 1.07$; $M_{ability} = 2.56$, $SD_{ability} = 1.00$) (perceived source expertise: $F[1, 38] = 3.66$, $p = .063$, $\eta_p^2 = .09$; ability to achieve closure: $F[1, 38] = 5.96$, $p = .019$, $\eta_p^2 = .14$). However,

there was no evidence of an added value of communicating (non-)consensus when participants anticipated to receive information from the Geophysicists. That is, participants did not appear to perceive higher source expertise or feel better able to achieve closure when the Geophysicists communicated consensus ($M_{expertise}$ = 5.66, $SD_{expertise}$ = 0.72; $M_{ability}$ = 3.50, $SD_{ability}$ = 1.19) versus non-consensus ($M_{expertise}$ = 5.33, $SD_{expertise}$ = 0.85; $M_{ability}$ = 3.45, $SD_{ability}$ = 0.90) (perceived source expertise: $F[1, 34] = 1.59$, $p = .216$; ability to achieve closure: $F[1, 38] < 1$, $p = .881$). Moreover, when we conducted separate bootstrapping analyses for each of the two source identity conditions (Preacher & Hayes 2008: 5000 resamples, bias corrected) this revealed that perceived expertise mediated the effect of the source consensus manipulation (0 = consensus, 1 = non-consensus) on ability to achieve closure in the Citizens Association condition (B = –0.31; 95% CI [–0.76, –0.03]; c' path B = –0.54, $p = .107$). Again, no such indirect effect occurred in the Geophysicists condition (B = –0.13; 95% CI [–0.47, 0.03]; c' path B = 0.10, $p = .770$). Taken together, these additional analyses consistently suggest that the communication of consensus primarily increases perceptions of source expertise—and thus increases the ability to achieve closure—when the identity of the source does not (already) contain clear cues to indicate high expertise (e.g., in the case of a lay information source).

Discussion

In sum, the results of Study 4.2 replicate and extend those of the first study, and offer support both Hypothesis 1 and Hypothesis 2. The findings again show the importance of perceived source expertise for people's ability to achieve closure on complex topics, and demonstrate that both source identity and communication of consensus can contribute to perceptions of source expertise. As in Study 4.1, we found that the identity of an information source influences perceptions of source expertise, and that higher levels of perceived source expertise in turn increase people's ability to form a closed attitude on a complex topic. Moreover, Study 4.2 extends the results of the previous study by demonstrating that for perceptions of source expertise, and thereby for people's ability to achieve closure, it is not only important *who* is providing the information, but also what *message* is being communicated. That is, we found that people regard an information source to have more expertise, and therefore feel better able to achieve closure, when it communicates consensus rather than non-consensus. Notably, the effects observed in the present research emerged independently of individual differences in need for closure or self-efficacy. This allows us to rule out such differences as alternative explanations for our findings and suggests that people's ability to achieve closure may be affected by source and message characteristics, regardless of

existing variations in people's individual needs and abilities relevant to the formation of a closed attitude. Finally, although the effects of source identity and consensus occur independently of one another as predicted, results on cognitive closure achieved and additional analyses suggest that that the added value of communicating consensus primarily emerges for sources with a non-expert identity.

General Discussion

Compared to open, "unfinished" attitudes, closed attitudes are better predictors of people's future attitudes and behavior (cf. Krosnick & Petty, 1995; Petty & Cacioppo, 1986b). As such, closed attitudes—attitudes on which people have achieved a state of cognitive closure—are also better predictors of people's support or opposition to a complex technology. Recent research has demonstrated that experimental manipulations of the extent to which people feel that they are able to achieve closure determine the level of cognitive closure that they actually achieve in their attitude formation concerning complex topics (Koot et al., 2014a). It is therefore important to examine which real-life factors impact on people's ability to achieve closure. To examine this, we connected to existing insights on the importance of communication and the provision of information for the formation of attitudes. Specifically, we examined the impact of the level of expertise that people perceive an information source to have on their ability to form a closed attitude on complex topics.

Results of the two experimental studies reported here consistently show that when people believe a source of information to have high, compared to low, expertise on the complex topic in question, they feel better able to form a closed attitude on the basis of the information provided by this source. Our results furthermore demonstrate that perceived source expertise not only depends on *who* is communicating, but is also affected by the *message* communicated by this source. That is, people attribute higher expertise to an information source that has an expert identity (i.e., geophysicists) compared to a non-expert identity (i.e., a citizens association). Likewise, a source that communicates consensus, rather than non-consensus, is seen as having more expertise on the topic in question. Perceptions of source expertise are relevant, because these subsequently increase the perceived ability to form a closed attitude on the complex topic in question. These effects were also visible in the extent to which people actually achieve cognitive closure in their attitude on a complex topic.

Theoretical Implications

The present research contributes to the existing literature in several ways. Results of two studies demonstrate that perceptions of the *expertise* of a particular source of information impact on people's ability to achieve closure on the basis of information provided by this source. A few studies so far have demonstrated that people's ability to achieve closure is susceptible to external influences. However, these have all employed relatively artificial manipulations (e.g., bogus feedback from a personality test; Koot et al., 2014a) to induce such differences. To our knowledge, the current research is the first to reveal how experiences that are more likely to emerge in real life settings may determine people's ability to make up their mind. In this way, the present results corroborate and extend emerging evidence that the ability to achieve closure not only indicates how individuals differ from each other, but is also a factor that can be influenced situationally, independently of such more stable individual differences. The effect of perceived source expertise we observed on the ability to achieve closure moreover extends previous findings from research on persuasion. That is, prior work has shown that information has a stronger impact on the *content* of people's attitudes (i.e., is more persuasive) when they believe that the information source has high, compared to low, relevant expertise (e.g., Cialdini & Goldstein, 2004; Pornpitakpan, 2004). We have complemented these insights by showing that perceived source expertise also affects the likelihood that people feel confident that they are *able* to form an attitude on the topic in question. As such, the present data again underline the significance of source expertise, and especially perceptions thereof, for the realm of attitude formation, but do this in a different way than in prior research.

In the present research, we established that people form an impression about the expertise of a particular source of information on the basis of its identity. At first sight, this may seem self-evident, and indeed, there are several studies in which source identity and source expertise are treated as interchangeable concepts (e.g., Bohner, Ruder, & Erb, 2002; Clark, Wegener, Habashi, & Evans, 2012; Mackie & Worth, 1989). Notwithstanding this prior work and the relation we observed between source identity and perceived expertise, the current research also demonstrates that the level of expertise that people attribute to a particular information source is not fixed. Instead, we demonstrated that the perceived level of expertise of a given source is also affected by the content of its message (cf. Reimer et al., 2004)—in this case the level of consensus communicated by the source. Of course, this could not be revealed in prior studies where the level of consensus remained unspecified or was held constant. However, we found that if an information source communicates that its members agree among themselves (instead

of disagreeing), people take this as a cue of high source expertise. Interestingly, our results seem to suggest that the added value of explicitly communicating consensus is particularly relevant for sources whose identities suggest low relevant expertise. By contrast, being informed about the level of consensus is less relevant for people's perceptions of a source that already is considered expert on the basis of its identity.

Our present findings also resonate with prior work on person perception (Cuddy, Glick, & Beninger, 2011; Fiske, Cuddy, & Glick, 2007). This research established that there is an asymmetry in the impact of explicit information that is provided about particular individuals, depending on pre-existing expectations that other people have about their competence. Specifically, when someone is expected to be relatively incompetent, any display of competence is seen as indicating the "true level" of competence, and is taken as evidence that the individual actually is more competent than was anticipated. By contrast, when someone is expected to be generally competent, a disappointing performance is not seen as very informative, as it tends be attributed to lack of care or motivation rather than being seen as diagnostic of the true ability of the individual in question. As a result, the knowledge of competent or incompetent behaviors has much less of an impact on the overall impression of someone who is a priori expected to be competent. Likewise, in our research the communication of (non-) consensus was less impactful in the case of an expert source. This parallel between prior work on person perception and individual impression formation and the present research on attitude formation and the ability to achieve closure suggests that there may be a more general asymmetry in the perceived value of explicit information, depending on pre-existing expectations people have. Future research may further explore this possibility, to examine whether a broader underlying mechanism may account for a larger corpus of findings from different literatures.

Practical Implications

The present findings have a number of very concrete and practical implications. They may be of particular interest for stakeholders involved in complex issues or projects that affect the public, such as a government planning the implementation of a novel technology or policy. Public opinion can be a decisive factor in the progress of political decision making or for the implementation of decisions already made. The present research helps understand under which circumstances people will feel most able of achieving the cognitive closure that is needed for declared opinions to be indicative of people's actual points of view. This is not to suggest, however, that the achievement of closure should be a goal in itself. In fact, there may be conditions under which it would be more appropriate to keep an open mind, for instance because crucial information

(e.g., about long-term effects of a technology) is not yet available. Ideally, individuals are thoroughly and well informed before forming their definite, closed attitude. If high quality and complete information can be provided, encouraging people to achieve closure may be appropriate. However, as long as the available information is of low quality, still incomplete, or possibly even false, there is little benefit in assessing people's stated opinions, or in encouraging them to achieve closure (cf. Lewandowsky et al., 2012). Communicators and opinion pollsters do well to take this into account when deciding whether and how to assess "public opinion" to gauge support for particular policies or activities.

Our results indicate that people take into account the expertise of a particular source when evaluating the usefulness of the information provided by this source. That is, receiving information from a source with higher perceived expertise causes people to feel strengthened in forming a closed attitude on complex topic, on which they themselves are no experts. This can be a comforting thought for those who strive to communicate high quality information to the general public and are confronted with the current reality in which abundant information of varying quality is available to the public (e.g., on the internet). The present research suggests that people who try to form an opinion will tend to filter and select information, depending on the identity of the source of this information. When informing the public on the basis of valid information from experts, it would thus make sense to explicitly state the identity of the information source. Emphasizing the expert identity should raise perceptions of source expertise and as such increase the extent to which people feel capable of forming their closed, definite attitude on the basis of the information provided.

Those who provide information on complex topics for the public interest should furthermore beware of the impact that seemingly innocuous statements embedded in the content of the message can have. Specifically, it may be important for members of an information source to draw a joint conclusion when possible, and if this is the case, to explicitly communicate such agreement. Indeed, our results suggest that people will take such consensus as indicating high knowledgeability of the source on the topic in question. Of course, in the case of many complex issues, such as the question of climate change, it may not always be possible to reach agreement about all relevant aspects. If this is the case, withholding the fact that there is an unresolved (scientific) debate on a public affair from the public would be irresponsible. At the same time, it is important to be aware of the possible impact that disclosure about such disagreement may have, and to take into account the possibility that it undermines perceptions of expertise. Knowing this may be the case makes it even more pressing to be explicit about people's professional qualifications, or to elaborate on the scientific evidence supporting

statements that are made. Indeed, the results from the present work seem to suggest that the negative effects of communicating lack of consensus are likely to be less pronounced when people are made aware of the expert identity of the source. This makes it all the more important to make salient the expert identity of an information source when the state of affairs of the topic in question (e.g., the development of nanotechnology) does not yet allow for the communication of consensus. That is, knowing that information is coming from experts will make people feel reasonably able to decide on their point of view on the basis of this information, despite the lack of consensus on the topic.

By contrast, the communication of consensus can increase people's reliance on information provided by a non-expert source. People may feel ready to make up their mind when a source with a lay status conveys a concordant conclusion, even when the actual quality of this information is unclear. The potential impact of non-experts communicating a strong and unanimous message should therefore not be underestimated by those charged with communicating about complex scientific and public projects. Parties that providing a podium for the debate on complex issues, such as the implementation of a novel technology, should be mindful of giving voice to lay parties that provide inaccurate information but nevertheless communicate a strong and unanimous message.

Limitations and Future Directions

We have interpreted the present results as indicating that the communication of (non-)consensus mainly affects perceived source expertise and ability to achieve closure when such confidence cannot be derived from the identity of the source. Nevertheless, we acknowledge that the present data are not conclusive on this point. Instead, they may reflect the specific nature of the manipulation we used to convey (lack of) consensus. That is, while we indicated that there was disagreement on what can be concluded about the net *consequences* of CCS for the environment, there was no sign of disagreement about the underlying *facts*. This form of disagreement may not have seemed very strong or problematic. Indeed, on the basis of the present work, we cannot exclude the possibility that a stronger level of disagreement might also undermine people's reliance on information provided by an expert source. We conducted an auxiliary study to explore this possibility (Koot, Ter Mors, Ellemers, & Daamen, 2014b). In this study, members of "the Association of Dutch Geophysicists and Sustainability" were said to agree or disagree about the facts underlying their stance towards CCS. In support of our current interpretation of the present findings, and similar to what we observed in Study 4.2, this stronger manipulation of (lack of) consensus did not affect perceived source expertise to such an extent that it lead to a significant decrease in people's ability

to achieve closure on the topic. Thus, despite the limitations of the present methodology, the available evidence actually suggests that an expert identity is quite a robust indicator of high expertise. Additional research can further address this question and more systematically establish the boundary conditions for this effect.

Now that we have established the relevance of communicating about source identity and consensus, future research might also address additional factors in communication that possibly impact on perceived expertise and subsequently the ability to achieve closure. For instance, people may be less impressed with information from one information source (i.e., perceive lower source expertise and feel less able to achieve closure) when they realize that there is also information available from sources with higher levels of expertise, compared to when they are unaware of such information. Exploring these issues would be a useful direction for future research.

When trying to ascertain the broader implications of our current findings, we acknowledge that the particular nature of our sample may have played a role in the responses we observed. Participants in the current research were Dutch university students. These are likely to deviate from a random sample of the general public in a number of ways. First, they may be more used to and hence overall more confident to form opinions on the basis of partial or inconsistent information. Indeed, as part of their academic training, they are prepared to deal with scientific nuance and to weigh the positions of experts advocating diverging points of view. This may have made our participants relatively unmoved by the communication of (non-)consensus in the case of an expert source. At the same time, one may argue that a more representative sample of the general population is likely to be more impressed with the expertise of geophysicists than university students who are used to interact with and question different types of experts. All in all, we acknowledge the specific nature of our sample, and future research might establish the broader applicability of these findings. Nevertheless, it is not self-evident whether or how the nature of our sample should have biased our results.

In a similar vein, it might be of interest to investigate the relation between source identity, perceived source expertise, and the ability to achieve closure in national contexts that differ in their overall level of scientific skepticism. In the Netherlands the general public has a relatively high level of trust in science (KNAW, 2013). It might be relevant to establish whether such overall differences also affect the sensitivity of the general public to additional or alternative indicators of potentially relevant expertise. For instance, in countries where people have less trust in science, communication of consensus by a source with a non-expert identity may be especially influential. Conversely, communicating lack of consensus among scientists might be more harmful in contexts where the status of scientists is more easily called into question. While we

think this does not invalidate the implications of the present research, it might be of interest to gain further insight in how different *a priori* levels of perceived expertise of different types of sources affect the impact of further information provided.

Conclusion

Results from two studies lead us to conclude that the level of expertise that people perceive an information source to have is an important determinant of how capable they feel of forming a closed attitude on complex topics. The identity of an information source emerges as an important determinant of people's impressions of the source's expertise. However, the level of expertise that people ascribe to a particular source is not fixed. When a source communicates consensus about the topic in question people perceive higher source expertise and as a consequence feel better able to achieve cognitive closure.

Appendix

Design, Stimulus Materials, and Results of the Two Distinct Data Collection Waves (Study 2)

Data Collection Wave I

In the first data collection wave we explored whether communicating an analogy of CCS would reduce participants' risk perception of and negative emotional reactions to the implementation of CCS, and whether this would lead to an increase in the level of cognitive closure they achieved on the topic. To ensure that the effects would not differ depending on CCS-component, we counterbalanced whether participants were prompted to think about CO_2 storage or about CO_2 transport.

Method

Participants and design. Participants were 97 students (33 men and 64 women; M_{age} = 20.32, SD = 2.99) who were randomly assigned to either one of the conditions of the 2 (CCS-component: CO_2 transport vs. CO_2 storage) × 2 (analogy use: analogy vs. no-analogy) design. They received either a monetary reward or course credit in return for their participation.

Procedure. The study was the first in a set of unrelated studies. The procedure and measures of this data collection wave were as described in the main text of Chapter 2. Depending on CCS-component condition, participants read information about CO_2 transport or CO_2 storage, and depending on analogy condition, this information did or did not include an analogy of the relevant CCS-component. Participants in the CO_2 transport condition (analogy and no-analogy) read the following information:

> CO_2 can be transported via pipelines, ships, or tanker trucks. The manner of transport that is selected depends on many aspects, such as the amount of CO_2 and the transport distance to the location where the CO_2 can be stored. Transport via pipelines is the most likely method in the Netherlands. These pipelines can be located below as well as above the ground. The CO_2 is compressed after it has been captured. Next, the CO_2 can be transported via the pipelines to the storage location.

Those in the CO_2 transport-analogy condition then also read:

> CO_2 transport via pipelines is comparable to transport of natural gas, where natural gas is transported via pipelines to provide households and businesses with gas.

Participants in the CO_2 storage condition (analogy and no-analogy) read the following information about the CCS-component:

> CO_2 can be stored in depleted natural gas fields, in depleted oil fields, and in so-called aquifers (water-bearing layers). Prior to the selection of CO_2 storage locations, investigations are carried out, after which the most suitable location is selected. Depleted natural gas fields are the most likely storage location for CO_2 in the Netherlands. To be able to store

> the CO_2 that has been captured, it is first compressed. The CO_2 is then inserted into the depleted natural gas field via an injection well where it is stored.

In the CO_2 storage-analogy condition participants then also read:

> CO_2 storage in depleted natural gas fields is comparable to storage of natural gas in these kinds of fields. Storage of natural gas in depleted natural gas fields takes place to enable effective responses to peaks in gas demand.

Results

To explore whether participants´ general risk perception, specific risk perceptions, negative emotional reactions, and their achievement of cognitive closure were affected by the use of an analogy or differed depending on CCS-component (CO_2 transport or CO_2 storage), we conducted Analysis of Variance (ANOVA) with analogy use and CCS-component as independent variables.

Results revealed no significant main or interaction effects of analogy use and CCS-component on general risk perception, $Fs(1, 93) \leq 3.08$, $ps \geq .083$, or on any of the specific risk perception dimensions (catastrophic potential, lack of control, and lack of familiarity), $Fs(1, 93) \leq 3.22$, $ps \geq .076$. Participants' negative emotional reactions to CCS also remained largely unaffected by analogy use and CCS-component. Analogy use and CCS-component had neither main nor interaction effects on outcome uncertainty-related emotions, $Fs(1, 93) \leq 1.59$, $ps \geq .210$. Results showed only a main effect of analogy use on outcome certainty-related emotions; participants who learned about a natural gas analogue of CCS experienced these emotions more intensely ($M = 2.45$, $SD = 1.36$) than those who did not learn about an analogous technology ($M = 1.91$, $SD = 0.92$), $F(1, 93) = 5.19$, $p = .025$, $\eta_p^2 = .05$. There was no main effect of CCS-component or interaction effect of analogy use and CCS-component on outcome certainty-related emotions, $Fs(1, 93) < 1$, $ps \geq .585$. Finally, the level of cognitive closure that participants achieved did differ depending on the CCS-component under consideration; participants who were asked to form an attitude on CO_2 transport achieved more cognitive closure ($M = 3.94$, $SD = 1.13$) than those who formed an attitude on CO_2 storage ($M = 3.50$, $SD = 1.05$), $F(1, 93) = 4.02$, $p = .048$, $\eta_p^2 = .04$. There was no main effect of analogy use or an interaction effect of analogy use and CCS-component on cognitive closure achieved, $Fs(1, 93) \leq 1$, $ps \geq .319$.

Data Collection Wave II

In the second data collection wave we focused on CO_2 storage only. In this wave, we did not only systematically vary whether participants learned about an analogous technology of CO_2 storage, but also whether this analogy contained information that alluded to the safety of the analogous technology. In this way, we aimed to explore whether communicating information that contained an analogy of CO_2 storage as well as safety-related information about the analogue would reduce participants' risk perception and negative emotional reactions to the implementation of the technology. Such reductions would then possibly lead to an increase in the level of cognitive closure that people achieved on the topic. Contrary to the first data collection wave, participants in the analogy conditions first learned about the analogy, and then read further information on the CCS-component.

Method

Participants and design. Participants were 122 students (24 men and 98 women; M_{age} = 20.00, SD = 2.69) who were randomly assigned to either one of three experimental conditions (analogy with safety information vs. analogy without safety information vs. no analogy). They received either a monetary reward or course credit in return for their participation.

Procedure. The study was the first in a set of unrelated studies. The procedure and measures of this data collection wave were as described in the main text of Chapter 2. Depending on experimental condition, participants read information about CO_2 storage that did or did not include an analogy. Specifically, participants in the "analogy with safety information" condition and the "analogy without safety information" condition first learned about a technology that is analogous to CO_2 storage in depleted natural gas fields; storage of natural gas in depleted natural gas fields. The text on the analogy in the "analogy with safety information" condition additionally contained information that alluded to the safety of the analogous technology. Participants in the "no analogy" condition did not learn about an analogy. Thus, the complete text on CO_2 storage in depleted natural gas fields in the "analogy with safety information" read as follows:

> Some parts of the CO_2 capture, transport, and storage technology are comparable to already existing technologies. For instance, storage of CO_2 in depleted natural gas fields is comparable to the storage of natural gas in these types of fields. Storage of natural gas in depleted natural gas fields takes place to enable effective responses to peaks in gas demand in winter. Underground storage of natural gas is a tried and tested method and has been taking place since the 1990s on several locations in the Netherlands. To store the natural gas, it is inserted in depleted

> natural gas fields via wells that were originally used for gas extraction. It has been demonstrated that the chance is virtually zero that natural gas will escape from the natural gas field in which it has been stored.
>
> CO_2 can be stored in different ways. Depleted natural gas fields are the most likely storage location for CO_2 in the Netherlands. Prior to the selection of CO_2 storage locations, investigations are carried out, after which the most suitable location for storage of the CO_2 is selected. To be able to store the CO_2 it is gathered at the depleted natural gas field. The CO_2 is then inserted into the depleted natural gas field via an existing well where it is stored. In this way, storage of CO_2 in depleted natural gas fields is comparable to the storage of natural gas in depleted natural gas fields.

Participants in the "analogy without safety information" read the following text:

> Some parts of the CO_2 capture, transport, and storage technology are comparable to already existing technologies. For instance, storage of CO_2 in depleted natural gas fields is comparable to the storage of natural gas in these types of fields. Storage of natural gas in depleted natural gas fields takes place to enable effective responses to peaks in gas demand in winter. To store the natural gas, it is inserted in depleted natural gas fields via wells that were originally used for gas extraction.
>
> CO_2 can be stored in different ways. Depleted natural gas fields are the most likely storage location for CO_2 in the Netherlands. Prior to the selection of CO_2 storage locations, investigations are carried out, after which the most suitable location for storage of the CO_2 is selected. To be able to store the CO_2 it is gathered at the depleted natural gas field. The CO_2 is then inserted into the depleted natural gas field via an existing well where it is stored. In this way, storage of CO_2 in depleted natural gas fields is comparable to the storage of natural gas in depleted natural gas fields.

And, finally, the information on CO_2 storage in depleted natural gas fields in the "no analogy" condition read:

> CO_2 can be stored in different ways. Depleted natural gas fields are the most likely storage location for CO_2 in the Netherlands. Prior to the selection of CO_2 storage locations, investigations are carried out, after which the most suitable location for storage of the CO_2 is selected. To be able to store the CO_2 it is gathered at the depleted natural gas field. The CO_2 is then inserted into the depleted natural gas field via an existing well where it is stored.

Results

To explore whether participants´ general risk perception, specific risk perceptions, negative emotional reactions, and achievement of cognitive closure were affected by the use of an analogy that either did or did not include safety-related information, we conducted Analysis of Variance (ANOVA). Results revealed no significant differences between the three experimental conditions on general risk perception, the three risk perception dimensions, negative outcome uncertainty-related emotions, or level of cognitive closure achieved Fs(1, 119) ≤ 2.54, ps ≥ .083. Thus, communication about a natural gas analogue of CO_2 storage (including or excluding safety information) did not affect these measures. Participants in the three conditions, however, did differ in the extent to which they experienced outcome certainty-related emotions, $F(1, 119) = 3.85$, $p = .024$, $\eta_p^2 = .06$. Bonferroni post hoc tests revealed that participants in the "analogy without safety information" condition experienced less outcome certainty-related emotions (e.g., anger, disappointment) ($M = 1.77$, $SD = 0.86$), than participants in the "analogy with safety information" condition ($M = 2.33$, $SD = 1.09$, $p = .051$) or the "no analogy" condition ($M = 2.32$, $SD = 1.14$, $p = .054$).

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Samenvatting

Technologische ontwikkelingen spelen in toenemende mate een belangrijke rol in de hedendaagse samenleving. Denk bijvoorbeeld aan de invloed die de smartphone heeft op onze manier van communiceren, of de wijze waarop ons voedsel tegenwoordig wordt geproduceerd (mechanisch, geautomatiseerd) in vergelijking met enkele decennia terug. Met grote regelmaat worden er nieuwe innovaties met diverse toepassingen geïntroduceerd, zoals duurzame methodes om energie op te wekken. In veel gevallen houdt toepassing van zo'n nieuwe, complexe technologie in dat burgers in aanraking komen met de technologie. Soms heeft een technologie zelfs directe invloed op het dagelijks leven. Als gevolg hiervan is de invoering van een complexe technologie doorgaans alleen mogelijk als zij door het publiek geaccepteerd wordt, zoals we tegenwoordig onder andere zien met het gebruik van elektrische auto's. De publieke opinie kan dus een doorslaggevende factor zijn voor de grootschalige inzet van een nieuwe technologische ontwikkeling. Gezien deze invloed van het publiek is het interessant en relevant voor partijen die betrokken zijn het invoeren van een complexe technologie (bv. beleidsmakers) om een beeld te krijgen van de publieke opinie over de technologie in kwestie, bijvoorbeeld door middel van opiniepeilingen. De standpunten, of attitudes, die mensen geven tijdens dit soort metingen zijn echter vaak "open". Dat wil zeggen dat het vormen van de attitude nog niet klaar is of de gegeven attitude gebaseerd is op weinig tot geen kennis over het betreffende onderwerp. Dergelijke "open", onvoltooide attitudes hebben weinig betekenis; het zijn geen goede voorspellers van toekomstige standpunten of van daaraan gerelateerd gedrag (zoals wel of niet protesteren tegen de invoering van een bepaalde complexe technologie). Echter, als mensen het vormen van hun attitude *wel*hebben afgerond – en deze dus is "afgesloten" – is deze attitude daarentegen een goede voorspeller van hun toekomstige standpunt en gedrag. Inzicht in welke factoren verbonden zijn aan het vormen van een afgesloten attitude kan daarom bijdragen aan een beter begrip van publieke opinievorming over de implementatie van nieuwe, complexe technologieën. De vraag is dus *wanneer* mensen hun attitudevorming afronden, wat ook wel bekend is als het bereiken van een staat van "cognitieve afsluiting" (*cognitive closure*).

Voorgaand onderzoek naar factoren die bepalen of mensen een staat van cognitieve afsluiting bereiken heeft zich voornamelijk gericht op de persoonlijke behoefte aan cognitieve afsluiting (*need for closure*). Mensen verschillen onderling en per situatie in hun behoefte om ergens snel een conclusie over te trekken of iets zeker te weten, dus om cognitieve afsluiting te bereiken. Een sterkere behoefte hieraan zorgt er in het algemeen voor dat mensen ook sneller en in hogere mate cognitieve afsluiting

bereiken over het onderwerp in kwestie. Echter, het is aannemelijk dat er ook andere factoren zijn die bepalen of mensen wel of niet deze mentale staat bereiken. Vooral in het geval van een ingewikkeld onderwerp als de invoering van een complexe technologie, zoals nanotechnologie, is het goed mogelijk dat mensen maar beperkt *in staat zijn* een afgesloten attitude te vormen, ongeacht hun persoonlijke *behoefte* om een dergelijke attitude te vormen. Mensen zijn zich waarschijnlijk vaak bewust van de complexiteit van onderwerpen zoals de inzet van technologische innovaties en kunnen daardoor het idee hebben dat hun vermogen om hierover een afgesloten attitude te vormen beperkt is. Als gevolg hiervan is het voor de meesten vaak erg lastig om een staat van cognitieve afsluiting te bereiken. Er zijn echter gevallen waarin mensen wel tot een definitief standpunt komen en hun attitudevorming over de inzet van een complexe technologie afsluiten. Het is daarom belangrijk om te begrijpen welke psychologische factoren ervoor zorgen dat mensen het moeilijker of makkelijker vinden om een staat van cognitieve afsluiting te bereiken over complexe technologische onderwerpen.

Het doel van dit proefschrift is het identificeren van psychologische factoren die het vormen van een gesloten attitude, of het bereiken van cognitieve afsluiting, over de invoering van een complexe technologie bevorderen of verhinderen. Ik richt me hierbij op factoren die geadresseerd kunnen worden in of door middel van publieke informatievoorziening over complexe technologieën. Een beter begrip van dergelijke factoren en de manier waarop zij het vormen van een afgesloten mening vergemakkelijken of belemmeren is uiterst relevant voor beleidsmakers die burgers op een zo goed mogelijke manier willen informeren. Door op de hoogte te zijn van welke factoren het vormen van een definitieve, afgesloten attitude compliceren of vergemakkelijken is het mogelijk om mensen op een dusdanige manier van informatie te voorzien dat zij een staat van cognitieve afsluiting kunnen bereiken.

Hoewel de mate waarin mensen cognitieve afsluiting bereiken belangrijke consequenties heeft, is het bereiken van deze staat niet in alle gevallen wenselijk. Daar waar goede en complete informatie over het onderwerp in kwestie beschikbaar is, is het in principe geen probleem wanneer mensen op basis van deze informatie een definitieve, afgesloten attitude vormen. Als de beschikbare informatie echter onvolledig of van lage kwaliteit is, doet men er goed aan om het afsluiten van de attitudevorming uit te stellen. In Hoofdstuk 1 geef ik een overzicht van de theoretische achtergrond en van de resultaten van de drie onderzoekslijnen in dit proefschrift. Ook worden de theoretische en praktische implicaties van mijn bevindingen besproken. In Hoofdstuk 2 onderzoek ik of en hoe mogelijk onrustbarende gedachtes en gevoelens, die zich vaak voordoen in reactie op de invoering van een complexe technologie, het bereiken van cognitieve afsluiting in de weg staan. Ik richt me hierbij specifiek op het waarnemen van risico's en

het ervaren van negatieve emoties. In Hoofdstuk 3 onderzoek ik of het waargenomen eigen vermogen om cognitieve afsluiting te bereiken het vormen van een definitieve, afgesloten attitude kan bevorderen. In Hoofdstuk 4 onderzoek ik of en hoe het vermogen om cognitieve afsluiting te bereiken over een complexe technologie beïnvloed wordt door kenmerken van de informatie die mensen hierover ontvangen. Ik kijk hierbij specifiek naar de rol van de mate van deskundigheid (expertise) die mensen toeschrijven aan een informatiebron.

Het onderzoek dat ik in dit proefschrift presenteer bestaat uit experimentele studies; hierin zijn één of meerdere elementen van de studie gevarieerd (bv. de identiteit van een informatiebron) waarna er door middel van vragen en gedragsmaten onderzocht is wat de gevolgen zijn van deze variaties voor de gedachten (ofwel cognities), gevoelens en het gedrag van de deelnemers van de studies. De vragen die in de huidige studies gesteld zijn en de gedragsmaten die zijn afgenomen richten zich hoofdzakelijk op de mate waarin deelnemers een staat van cognitieve afsluiting hebben bereikt over een complexe technologie. Een voorbeeld van een gedragsmaat is de keuze van een deelnemer om wel of niet mee te doen aan een opiniepeiling over de invoering van een complexe technologie. De keuze om mee te doen geeft in dit geval aan dat de deelnemer een zekere mate van cognitieve afsluiting heeft bereikt.

De complexe technologie waarover de deelnemers van de studies in dit proefschrift een attitude vormen is CO_2-afvang en -opslag technologie. Deze technologie is ook wel bekend als CCS, naar de Engelse term *carbon capture and storage*. Het doel van CCS is om de uitstoot van het broeikasgas CO_2 in de atmosfeer te verminderen en hiermee opwarming van de aarde tegen te gaan. Dit gebeurt door CO_2 af te vangen dat vrijkomt bij verbranding van fossiele brandstoffen, bijvoorbeeld in energiecentrales, en deze vervolgens te transporteren naar een ondergrondse opslagplek. In Nederland zijn lege aardgasvelden hier het meest geschikt voor. Het afgevangen CO_2 wordt vervolgens samengeperst en permanent, diep onder de grond opgeslagen. Net als in het geval van vele andere complexe technologieën kan de publieke opinie bepalend zijn voor de succesvolle invoering van CCS. Dat is onder andere gebleken toen in 2010 de plannen voor een CCS-demonstratieproject in de gemeente Barendrecht werden geschrapt wegens een gebrek aan draagvlak voor deze plannen onder de bevolking. CCS is daarmee een geschikt onderwerp om het vormen van afgesloten attitudes over complexe technologieën te onderzoeken.

In Hoofdstuk 2 van dit proefschrift richt ik mij op de risico's die mensen waarnemen en de negatieve emoties die ze ervaren wanneer ze geconfronteerd worden met de invoering van een complexe technologie zoals CCS. Specifiek onderzoek ik of en hoe deze veel voorkomende reacties het vormen van een afgesloten attitude in de

weg staan. Risico perceptie en negatieve emoties worden zowel in de literatuur als in de praktijk gezien als belangrijke bronnen van protest tegen de invoering van complexe technologieën. Ik stel echter dat deze reacties ook van invloed kunnen zijn op de mate van cognitieve afsluiting die mensen bereiken. Dat wil zeggen; het waarnemen van risico's en het ervaren van negatieve emoties kunnen het vormen van een afgesloten attitude verhinderen. De resultaten van dit onderzoek laten zien dat hoe meer mensen CCS als riskant zien in termen van rampzalige consequenties ("als er iets mis gaat, dan heeft dat heel ernstige gevolgen"), in termen van de bekendheid van risico's ("in hoeverre zijn we op de hoogte van wat er allemaal mis kan gaan?") en hoe meer ze emoties ervaren die onzekerheid aangeven (bv. angst en bezorgdheid), des te minder ze hun attitude over CCS zullen afsluiten. Onzekerheid is een gemene deler van deze vormen van risicoperceptie en het soort negatieve emoties die het bereiken van cognitieve afsluiting in de weg blijken te staan. De onzekerheid die mensen voelen wanneer ze deze risico's waarnemen of negatieve emoties ervaren zou overgedragen kunnen worden op het attitudevormingsproces, met als gevolg dat zij zich niet goed in staat voelen om cognitieve afsluiting te bereiken. De mate waarin mensen zichzelf capabel achten om een afgesloten attitude te vormen zou op zijn beurt een verklaring kunnen zijn voor het feit dat sommigen er meer, en anderen er minder in slagen om een staat van cognitieve afsluiting te bereiken.

In Hoofdstuk 3 onderzoek ik de vraag of de mate waarin mensen het idee hebben dat ze een staat van cognitieve afsluiting kunnen bereiken inderdaad beïnvloedt of ze daadwerkelijk een afgesloten attitude vormen over de invoering van een complexe technologie zoals CCS. Het beeld dat mensen hebben van zichzelf met betrekking tot het kunnen vormen van een afgesloten attitude wordt ook wel het "vermogen om cognitieve afsluiting te bereiken" genoemd. In twee studies varieerde ik het vermogen van deelnemers om cognitieve afsluiting te bereiken door ze een fictieve persoonlijkheidstest te laten maken en ze vervolgens een valse uitslag van deze test te geven. De ene helft van de deelnemers kreeg te horen dat hun vermogen om cognitieve afsluiting te bereiken over complexe onderwerpen groot was, terwijl de andere helft van de deelnemers werd verteld dat hun vermogen op dit gebied als gemiddeld was. Hierna werden alle deelnemers gevraagd om hun attitude te vormen over een specifiek complex onderwerp, namelijk de invoering van CCS in Nederland. Vervolgens werd de mate waarin ze een afgesloten attitude hadden gevormd gemeten door middel van een vragenlijst en een gedragsmaat. Ten slotte werd er gemeten in hoeverre de deelnemers nog open stonden voor aanvullende informatie over de invoering van CCS in Nederland. In de eerste studie werd dit gedaan door vast te stellen hoeveel aanvullende informatie de deelnemers besloten te lezen en hoeveel van deze informatie ze gebruikten om hun standpunt te

onderbouwen wanneer hierom gevraagd werd. In de tweede studie werd het openstaan voor aanvullende informatie gemeten door de deelnemers een lijst met interviews over CCS aan te bieden ("geopinieerde" informatie) en een lijst met krantenartikelen over CCS (feitelijke informatie). De deelnemers gaven vervolgens hun interesse in de informatie aan en kozen de interviews en artikelen die ze zouden willen lezen.

Beide studies lieten zien dat deelnemers die de indruk hadden gekregen dat ze een groot vermogen hadden om cognitieve afsluiting te bereiken inderdaad een meer afgesloten attitude vormden dan mensen die te horen hadden gekregen dat hun vermogen hiertoe gemiddeld was. Dit betekent dat mensen die zichzelf beter in staat achten om een afgesloten attitude te vormen hier ook beter in slagen dan mensen die het beeld van zichzelf hebben dat ze hier minder vaardig in zijn. Dit toont aan dat het ervaren vermogen om cognitieve afsluiting te bereiken inderdaad een bepalende factor is voor of mensen wel of niet een afgesloten attitude zullen vormen. De resultaten toonden verder aan dat hoe meer mensen hun attitudevorming over de complexe technologie in kwestie hebben afgerond, des te minder zij open staan voor aanvullende informatie. Dit verband tussen het afsluiten van een attitude en openstaan voor aanvullende informatie lijkt echter alleen te gelden wanneer de informatie gerelateerd is aan de standpunten van anderen (geopinieerde informatie) en niet voor feitelijke informatie. Geslotenheid voor nieuwe, geopinieerde informatie kan problematisch zijn, bijvoorbeeld wanneer een beleidsmaker zijn of haar redenen voor het uitvoeren een project duidelijk wil maken aan het publiek. De resultaten suggereren echter dat een dergelijk probleem zich minder snel zal voordoen wanneer er nadruk wordt gelegd op de feiten waarmee de argumenten onderbouwd worden. In een dergelijke situatie zouden mensen met een afgesloten attitude waarschijnlijk in dezelfde mate open staan voor geopinieerde informatie als mensen die minder vergevorderd zijn in hun attitudevorming.

In Hoofdstuk 4 laat ik zien dat het vermogen van mensen om een staat van cognitieve afsluiting te bereiken niet alleen beïnvloed kan worden door middel van experimentele, kunstmatige methodes (bv. valse uitslag van een fictieve persoonlijkheidstest), maar ook door factoren uit het dagelijks leven, zoals kenmerken van communicatie over de invoering van een complexe technologie. Ik richt me hierbij in het bijzonder op hoe de expertise die mensen toeschrijven aan een informatiebron kan bepalen in hoeverre zij in staat zijn om een afgesloten mening te vormen op basis van de informatie van de bron. Het huidige onderzoek laat zien dat mensen beter een afgesloten attitude over de invoering van CCS kunnen vormen wanneer zij denken dat ze informatie ontvangen van een bron die zeer deskundig is op het gebied van de technologie. Het blijkt dat mensen hun indruk van de expertise van een informatiebron baseren op de identiteit van de bron. Dit betekent dat mensen het idee hebben dat

ze beter in staat zijn om een definitieve, afgesloten attitude te vormen op basis van informatie van bepaalde bronnen (bv. een wetenschappelijke vereniging) dan van andere (bv. een burgerorganisatie). Echter, dit betekent niet dat deze waargenomen expertise van een bron in alle situaties hetzelfde is; de indruk die mensen hebben van de deskundigheid van een informatiebron blijkt ook af te hangen van de boodschap die de bron communiceert. Wanneer de leden van een informatiebron aangeven dat ze het onderling eens zijn, in plaats van oneens, over het onderwerp in kwestie (in dit onderzoek de gevolgen van CCS voor het milieu), nemen mensen meer bronexpertise waar. Dit heeft als gevolg dat mensen zich ook beter in staat voelen om een afgesloten attitude te vormen wanneer een bron aangeeft dat haar leden het onderling eens zijn, en dat er dus consensus is in plaats van onenigheid. Dit effect van het communiceren van consensus (versus onenigheid) op waargenomen bronexpertise en het vermogen om een afgesloten attitude te vormen lijkt niet even sterk te zijn voor alle bronnen. Met name wanneer de identiteit van de bron in kwestie geen reden is om aan te nemen dat men met experts te maken heeft – zoals in het geval van een burgervereniging die informatie geeft over een complexe technologie als CCS – lijkt het communiceren van consensus of onenigheid gevolgen te hebben. Wanneer de identiteit van de bron echter al hoge expertise aangeeft, zoals in het geval van een wetenschappelijke vereniging, lijkt de vraag of de leden het onderling eens of oneens zijn echter minder van belang te zijn voor de indruk die mensen hebben van de bronexpertise. Dit betekent dat bij het communiceren van informatie die afkomstig is van deskundigen het belangrijk is om de expert-identiteit van de bron te benadrukken. Op deze manier kan worden voorkomen dat de boodschap die gecommuniceerd wordt afdoet aan de waargenomen bronexpertise en daarmee ook dat het vermogen van de ontvangers van deze informatie om een afgesloten attitude te vormen vermindert. Tegelijkertijd tonen deze bevindingen aan dat men niet moet onderschatten in welke mate informatie van niet-experts kan bijdragen aan het vermogen van het publiek een staat van cognitieve afsluiting te bereiken over het onderwerp in kwestie, vooral als deze niet-experts aangeven het met elkaar eens te zijn.

Conclusie

Dit proefschrift toont aan dat het belangrijk is om oog te hebben voor het vermogen van mensen om een staat van cognitieve afsluiting te bereiken. Dit geldt zowel wanneer men publieke opinievorming over complexe technologieën beter wil begrijpen als wanneer men de publieke opinievorming wil ondersteunen middels informatievoorziening. Het vermogen om cognitieve afsluiting te bereiken blijkt namelijk bepalend te zijn voor de mate waarin mensen een afgesloten attitude vormen. Het afsluiten van attitude heeft belangrijke consequenties voor de stabiliteit van deze

attitude en de openheid van mensen voor aanvullende, geopinieerde informatie over het onderwerp in kwestie. Het vermogen om cognitieve afsluiting te bereiken is niet alleen een individueel kenmerk. Het kan ook beïnvloed worden door externe factoren en omstandigheden, onafhankelijk van de *behoefte* aan cognitieve afsluiting. Dit vermogen hangt af van kenmerken van de informatiebron die over de complexe technologie communiceert en van de boodschap die de bron gecommuniceerd. Het vermogen om cognitieve afsluiting te bereiken, of om een afgesloten attitude te vormen, blijkt tevens af te hangen van de risico's die mensen waarnemen en de negatieve emoties die ze ervaren als ze met de invoering van de technologie geconfronteerd worden. Zodoende geven de resultaten uit dit proefschrift nieuwe inzichten in de mechanismes die onderliggend zijn aan het vormen van definitieve, afgesloten attitudes. Naast deze bijdrage aan de literatuur hebben de huidige bevindingen ook praktische implicaties door handvaten te bieden voor het ontwikkelen van communicatiestrategieën die mensen kunnen helpen bij het bereiken van een staat van cognitieve afsluiting.

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Curriculum Vitae

Charlotte Koot was born in Nijmegen on April 3rd, 1986. She grew up in Dordrecht where she graduated from the Johan de Witt Gymnasium in 2004. After doing volunteer work in Northern Ghana and traveling the country, she started studying Social Sciences at University College Roosevelt in Middelburg in 2005. As part of her studies she went on exchange to the University of California, Davis (USA). Charlotte obtained her bachelor's degree in 2008 (summa cum laude). In 2010, she obtained her Research Master's degree in Social Psychology (cum laude) from the VU University Amsterdam. For her master's thesis she conducted research under supervision of Dr. David Amodio at New York University (USA). In August 2010, Charlotte started a PhD project at Leiden University within the CATO-2; the Dutch national research program on carbon dioxide capture and storage technology (CCS). This project was supervised by Prof. Dr. Naomi Ellemers and Dr. Emma ter Mors and resulted in the present dissertation. Charlotte currently lives in Amsterdam.

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Many of the technological innovations introduced into modern society have a clear impact on people's daily lives. As a consequence, public opinion is often a decisive factor for the successful implementation of a complex technology. The research in this dissertation examines psychological factors that affect the ease with which people form a definite view, or achieve cognitive closure, on complex technologies. Attitudes on which people have achieved cognitive closure are of interest as they are more stable and better predictors of people's behavior (e.g., protesting a complex technology) than open, unfinished attitudes. The studies in this dissertation focus on attitude formation about the complex technology of carbon dioxide capture and storage (CCS). Results show that the extent to which people feel able to form an attitude about a complex technology affects the level of cognitive closure they actually achieve. People's ability to achieve cognitive closure depends on the risks they perceive and negative emotions they experience in association with the technology as well as on characteristics of communication about the technology. Together these findings add to the understanding of public opinion regarding the implementation of complex technologies and provide novel insight into the mechanisms underlying the achievement of cognitive closure.

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