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## **Origins and consequences of public trust : towards an understanding of public acceptance of carbon dioxide capture and storage**

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### Competence-based and integrity-based trust<sup>4</sup>

Preventing climate change is among the greatest environmental challenges facing the world today. In addition to saving on energy consumption and increasing the use of sustainable energy sources, implementation of recently developed carbon dioxide capture and storage technology (CCS) is currently considered an important option to achieve climate change mitigation. This technology involves the capture, transport, and long-term storage of carbon dioxide in underground sites, such as depleted gas fields.

Interested organizations (e.g., industrial organizations, environmental NGOs) associate several environmental and economic risks and benefits with CCS (Huijts, Midden, & Meijnders, 2007). These organizations will take into account their assessments of these risks and benefits to determine their organizational positions on CCS implementation. Members of the general public, on the other hand, lack individual expertise about CCS (de Best-Waldhober, Daamen, & Faaij, in press; see also Chapter 4 of this thesis) and about scientific constructs such as carbon dioxide in general (Meijnders, Midden, & Wilke, 2001) to be able to accurately assess the risks and benefits of this new technology. As a consequence, and in line with previous research on other complex technological advancements (Siegrist & Cvetkovich, 2000), people will base their attitudes toward CCS on their assessments of the organizations having an involvement in CCS rather than on their personal knowledge about the issue.

Lay attitudes toward CCS are relevant because a lack of public acceptance can severely reduce the viability of CCS. The 1995 case of Brent Spar illustrates this point. In this instance, industrial organization Shell preferred the deep-sea disposal over the onshore disposal of Brent Spar, its decommissioned oil storage and loading structure. Shell had assessed the environmental risks of deep-sea disposal and concluded that these were negligible. Environmental organization Greenpeace, however, portrayed the deep-sea disposal option as highly risky,

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<sup>4</sup> This chapter is based on Terwel, Harinck, Ellemers, and Daamen (2009a) and has therefore been written in first-person plural.

which instigated considerable public opposition to Shell's position on the issue. Ultimately, this lack of public acceptance forced Shell to develop an alternative to the deep-sea disposal of the Brent Spar (for a more detailed description of the Brent Spar case, see Löfstedt and Renn, 1997). In a similar vein, public acceptance will be crucial for the realization of CCS as a strategy to mitigate climate change. As such, it is highly relevant to examine how people decide to accept or oppose CCS. This chapter addresses this issue.

### **Trust in organizations**

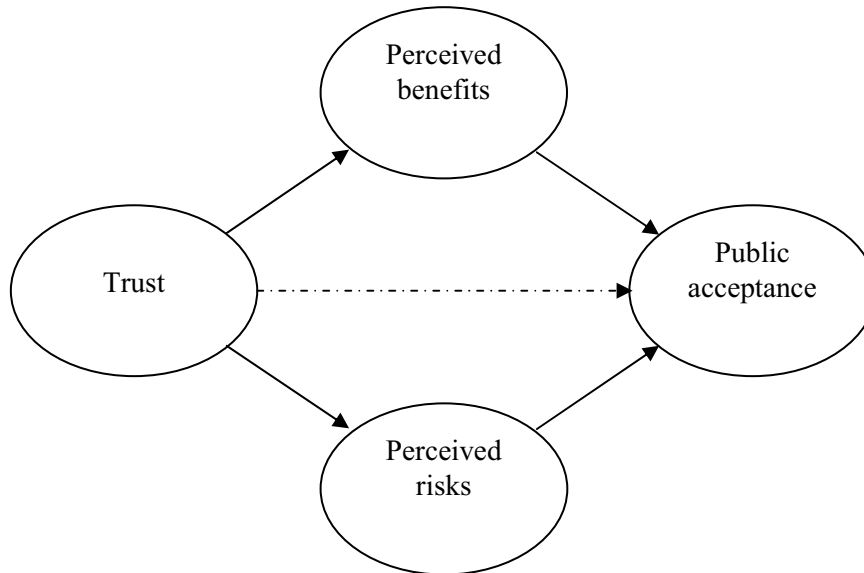
Siegrist's work on public acceptance of gene technology (Siegrist, 2000) served as a starting point for our inquiry. In this work, Siegrist showed that people's trust in organizations that are responsible for the management and use of gene technology affected their perceptions of the risks and benefits associated with this technology. He further showed that individual perceptions of risks and benefits affected acceptance of the technology. In other words, Siegrist's research suggests a causal model in which lay judgments concerning risks and benefits associated with modern technologies are expected to mediate the influence of trust in organizations on public acceptance of such technologies. Eiser and colleagues (Eiser, Miles, & Frewer, 2002) have referred to this model as the *causal chain account of trust* (see Figure 2.1).

To be able to understand how trust in CCS stakeholders affects lay perceptions of risks, perceptions of benefits, and acceptance of CCS, we first need to identify the factors that may cause people to trust these organizations in the first place. It stands to reason that this issue has received considerable scholarly attention in the field of risk research. Risk researchers have shown that people's trust in organizations that are responsible for the management of hazardous activities and complex technologies may depend upon several factors, including whether organizations are perceived to be accurate and objective, concerned with the public interest, consistent and predictable, honest and fair, and to have expertise relevant to the issue at hand (for an overview, see Poortinga & Pidgeon, 2003).

It has been suggested that these factors can roughly be classified into two overarching categories (Jungermann, Pfister, & Fischer, 1996; Metlay, 1999), the first comprising of indicators of organizational competence and the second comprising of indicators of organizational integrity. This perspective on trust recognizes that people may trust an organization because they think it has a lot of expertise about and experience with the issue under consideration, and/or because

they consider it to be open and honest in its communications and concerned with the public interest. Accordingly, trust based on organizational experience and expertise can be referred to as competence-based trust; trust based on organizational honesty, openness and concern can be referred to as integrity-based trust.

**Figure 2.1** The causal chain account of trust



Distinguishing between competence-based trust and integrity-based trust may yield important insights into how trust in organizations affects public perceptions of new technologies such as CCS. Previous research has already suggested the relevance of distinguishing between these types of trust (Kim, Dirks, Cooper, & Ferrin, 2006; Kim, Ferrin, Cooper, & Dirks, 2004). For example, Kim and colleagues (Kim et al., 2004) showed that the success of strategies to repair trust depends on the type of trust that was initially violated. Trust was more successfully repaired by means of apologizing than by denial when the trust violation concerned a matter of competence. When the trust violation concerned a matter of integrity, however, trust was more successfully repaired by denying instead of apologizing. These findings suggest that considering different bases for

trust can have important implications for subsequent evaluations of persons and organizations. Thus far, however, it has remained unclear whether distinguishing between competence-based trust and integrity-based trust has implications for people's judgments of the risks and benefits associated with new technologies and their acceptance of these technologies. The goal of the present research was to address this issue.

Drawing a distinction between competence-based trust and integrity-based trust is important, we argue, to be able to understand the process through which trust affects lay attitudes toward new technologies. This argument has its roots in findings from person-perception and impression-formation research, which suggest that people tend to weigh positive information about competence more heavily than negative information about competence (Reeder, Hesson-McInnis, Krohse, & Scialabba, 2001), but tend to weigh negative information about integrity more heavily than positive information about integrity (Trafimow, Bromgard, Finlay, & Ketelaar, 2005). In other words, positivity biases are more likely to occur in the ability domain, while negativity biases are more likely to occur in the integrity domain (Reeder & Brewer, 1979; Skowronski & Carlston, 1989).

In line with the abovementioned information asymmetry, we predict *positive* rather than negative information about the competence of an organization to affect lay attitudes toward CCS. More specifically, we expect people to pay attention to the organizational position concerning CCS when the organization is seen as competent, which implies that knowledge of the organizational position is more relevant when competence-based trust is high rather than low. In the case of high competence-based trust, we anticipate people to become more positive about CCS when the organization is a proponent than when it would have been an opponent. In the case of low competence-based trust, however, the organizational position is less likely to influence lay attitudes toward CCS.

By contrast, we predict *negative* rather than positive information about the integrity of an organization to influence lay attitudes toward CCS. Thus, compared to the way people are expected to use competence-based trust in the attitude formation process, we predict the reverse relation to hold true for integrity-based trust. When an organization is seen to lack integrity, people are likely to be skeptical about the position advocated by the organization and will tend to run counter to rather than go along with this position. In other words, when integrity-based trust is low, people will become less positive when the organization is a proponent (compared to an opponent) of CCS implementation. Consistent with the

information asymmetry principle, the effects of organizational position on people's attitudes toward CCS should be less pronounced in the case of high as opposed to low integrity-based trust.

### **Overview of the current studies**

The goal of the present research was to test the causal chain account of trust for both competence-based and integrity-based trust in the context of CCS. The vast majority of previous research that focused on public acceptance of new technologies and hazardous activities in relation to the variables in the causal chain model (i.e., trust in organizations, perceived risks, and perceived benefits) has relied on correlational data (e.g., Maeda & Miyahara, 2003; Poortinga & Pidgeon, 2005; Siegrist, 1999, 2000; Tanaka, 2004; Tokushige, Akimoto, & Tomoda, 2007). To complement this previous work, we used an experimental approach suited to test our predictions with regard to the differential implications of competence-based trust and integrity-based trust for acceptance of CCS.

In two experiments, we manipulated the provision of trust-related information about an organization involved in CCS decision making as well as the position of this organization regarding CCS, but the nature of the trust-related information was different in the two studies. In Study 2.1, which focused on competence-based trust, information about the competence of the organization was manipulated by informing participants about its (lack of) experience with and expertise about issues concerning carbon dioxide. In Study 2.2, which addressed integrity-based trust, information about (lack of) integrity of the organization was manipulated by informing participants about organizational honesty, openness, and concern for public interests. In both studies, we tested whether the causal chain model accurately explained people's acceptance of CCS.

### **Study 2.1**

Study 2.1 aimed to examine the prediction that organizational position concerning CCS implementation (pro versus con) more strongly affects people's acceptance of CCS in the case of high competence-based trust than in the case of low competence-based trust (Hypothesis 1). In accordance with the causal chain account, we further predicted people's perceptions of the magnitude of risks and benefits associated with CCS to mediate the effect of competence-based trust and organizational position on acceptance of CCS (Hypothesis 2).

## Method

### Participants and design

The sample consisted of 73 undergraduate students from Leiden University (38 male and 35 female). These participants were randomly assigned to one of the four experimental conditions of the 2 (competence-based trust: high vs. low) by 2 (organizational position regarding CCS implementation: pro vs. con) between-subjects factorial design.

### Procedure

Participants read a brief description about recently developed CCS technology and about “Organization A”, an organization involved in the decision-making process concerning the implementation of this technology. We gave the organization this name in order to exclude the possibility that the actual identity of the organization or previous knowledge about this organization would interfere with the manipulations. We informed participants that the organization really existed, but that it was denoted in this way for the purpose of ensuring the anonymity of the organization. Next, we provided participants with some information about organization A allegedly to give them some general background information. This information contained the experimental manipulations.

Participants in the high competence-based trust condition read: “Organization A is an organization that has *quite a lot of* knowledge about and experience with issues concerning carbon dioxide (CO<sub>2</sub>). In fact, the information that Organization A provides on this topic is often accurate”. Participants in the low competence-based trust condition read: “Organization A is an organization that has *limited* knowledge about and experience with issues concerning carbon dioxide (CO<sub>2</sub>). In fact, the information that organization A provides on this topic is not always accurate” (italics added to highlight the differences between the two stimulus materials).

Next, we manipulated the position of Organization A regarding CCS. Dependent upon experimental condition, participant read that Organization A is a proponent or that Organization A is an opponent of CCS implementation. After these manipulations, participants read that, when Organization A was asked to evaluate CCS, it referred to two risks and two benefits associated with CCS. Participants read about these risks and benefits, which included an environmental benefit, an economic benefit, an environmental risk, and an economic risk. For example, the environmental benefit provided was that CCS would help to mitigate

climate change, while the environmental risk was that CCS would go at the expense of more sustainable solutions. We varied the order of presentation of the risks and benefits to rule out order effects. Finally, participants completed a questionnaire including the main dependent variables and manipulation checks.

### **Dependent variables**

*Manipulation checks.* The manipulation check for trust in Organization A consisted of three items ( $\alpha = .95$ ), “To what extent do you think Organization A is trustworthy?”, “To what extent are you willing to rely on the judgments of Organization A?”, and “To what extent do you trust Organization A?” (1 = *not at all*, 7 = *very much*). The manipulation check for the position of Organization A with regard to CCS consisted of the question “Is Organization A an opponent or a proponent of CCS technology?” (1 = *proponent*, 2 = *opponent*). We asked these manipulation checks at the end of the questionnaire.

*Acceptance of CCS.* Acceptance of CCS was assessed with four items ( $\alpha = .91$ ). Examples of items were “I will support the actual implementation of this recently developed CCS technology.” and “I am willing to pay more for a product if CCS is applied during the production process.” (1 = *completely agree*, 7 = *completely disagree*).

*Perceived magnitude of risks and benefits.* Perceived magnitude of the risks associated with CCS was assessed for the environmental risk and the economic risk separately. For each risk, participants answered the questions: “Can you give an indication about how you judge the size of this risk associated with CCS?” (1 = *no risk at all*, 7 = *great risk*), and “Can you give an indication about how you judge the importance of this risk associated with CCS?” (1 = *not important at all*, 7 = *very important*). We used an identical procedure to assess perceived benefits associated with CCS. Scores on these questions were averaged into a single index for perceived risk ( $\alpha = .67$ ) and an index for perceived benefit ( $\alpha = .83$ ).

## **Results**

### **Manipulation checks**

We conducted analysis of variance (ANOVA) with organizational competence (high vs. low) and organizational position (pro vs. con) as independent variables and trust in Organization A as dependent variable in order to check whether the information about organizational competence indeed affected trust in the



organization. This analysis revealed a strong main effect for organizational competence,  $F(1, 69) = 94.31, p < .001, \eta^2 = .58$ . Participants who read that the organization had knowledge and experience concerning issues related to carbon dioxide reported more trust in the organization ( $M = 5.24, SD = 0.82$ ) than participants who read that the organization had only limited knowledge and experience ( $M = 3.52, SD = 0.71$ ). This analysis also revealed a marginally significant main effect for organizational position,  $F(1, 69) = 3.88, p < .06, \eta^2 = .05$ , indicating that participants who read that the organization was a proponent of CCS implementation had slightly less trust in the organization ( $M = 4.20, SD = 1.20$ ) than participants who read that the organization was an opponent of CCS ( $M = 4.58, SD = 1.10$ ). There was no interaction effect on this manipulation check,  $F(1, 69) = 0.25, ns$ . As such, we successfully manipulated the level of competence-based trust in Organization A independent of organizational position.

With regard to the organizational-position manipulation, all participants in the pro-CCS condition correctly answered that Organization A was a proponent of CCS implementation. All participants in the con-CCS condition correctly answered that the organization was an opponent of CCS implementation.

### **Acceptance of CCS**

We conducted an ANOVA with competence-based trust (high vs. low) and organizational position (pro vs. con) as independent variables and acceptance of CCS as dependent variable. This analysis revealed main effects of competence-based trust,  $F(1, 69) = 4.98, p < .03, \eta^2 = .07$ , and organizational position,  $F(1, 69) = 7.87, p < .01, \eta^2 = .10$ . These effects were qualified by a significant Competence-based Trust by Organizational Position interaction,  $F(1, 69) = 21.18, p < .001, \eta^2 = .24$ . As predicted, simple main effect analyses revealed that, in the case of high competence-based trust, participants accepted CCS to a greater extent when the organization was a proponent ( $M = 4.71, SD = 0.79$ ) than when it was an opponent of CCS ( $M = 3.28, SD = 0.76$ ),  $F(1, 70) = 26.75, p < .001$ . In the case of low competence-based trust, however, participants' acceptance of CCS did not depend on whether the organization was a proponent ( $M = 4.25, SD = 1.00$ ) or an opponent ( $M = 4.60, SD = 0.73$ ),  $F(1, 70) = 1.51, p > .22$ . These results support the prediction formulated in Hypothesis 1 and indicate that people use high rather than low competence-based trust as a guide in attitude formation about CCS.

### Perceived magnitude of risks and benefits

We also performed ANOVA to test whether competence-based trust and organizational position affected people's perceptions of the magnitude of risks and benefits referred to by the organization. With regard to perceived magnitude of risks, the analysis revealed a main effect of organizational position,  $F(1, 69) = 7.98, p < .01, \eta^2 = .10$ , qualified by a significant Competence-based Trust by Organizational Position interaction,  $F(1, 69) = 11.09, p < .001, \eta^2 = .14$ . Simple main effect analyses revealed that, in the case of high competence-based trust, participants who had read that the organization was a proponent of CCS judged the risks associated with CCS to be smaller ( $M = 4.22, SD = 0.83$ ) than participants who had read that the organization was an opponent of CCS ( $M = 5.12, SD = 0.53$ ),  $F(1, 70) = 19.44, p < .001$ . As predicted, in the case of low organizational competence, participants' judgments of risks did not depend on whether the organization was a proponent ( $M = 4.59, SD = 0.49$ ) or an opponent ( $M = 4.52, SD = 0.60$ ),  $F(1, 70) = 0.13, p > .70$ . Thus, in line with predictions, perceptions of risks were only influenced by organizational position when competence-based trust was high.

The reversed pattern of results appeared with regard to perceived magnitude of benefits associated with CCS. The analysis revealed a significant main effect of organizational position,  $F(1, 69) = 14.11, p < .001, \eta^2 = .17$ , and a main effect of competence-based trust,  $F(1, 69) = 4.12, p < .05, \eta^2 = .06$ , which were qualified by a significant Competence-based Trust by Organizational Position interaction,  $F(1, 69) = 31.42, p < .001, \eta^2 = .31$ . Simple main effect analyses revealed that, in the case of high competence-based trust, participants judged the benefits of CCS to be larger when the organization was a proponent ( $M = 5.56, SD = 0.45$ ) compared to an opponent of CCS ( $M = 4.15, SD = 0.58$ ),  $F(1, 70) = 43.02, p < .001$ . In the case of low competence-based trust, participants' judgments of the benefits did not depend on whether the organization was a proponent ( $M = 5.02, SD = 0.86$ ) or an opponent ( $M = 5.30, SD = 0.62$ ),  $F(1, 70) = 1.61, p > .21$ . Thus, in line with predictions, perceptions of benefits were only influenced by organizational position when competence-based trust was high. These findings support the causal relationship between trust and perceptions of risks and benefits as predicted on the basis of the causal chain model.

### Mediation analysis

We used the stepwise procedure recommended by Baron and Kenny (1986) to test whether perceptions of the magnitude of risks and benefits mediated the Competence-based Trust by Organizational Position interaction on people's acceptance of CCS (i.e., the causal chain account as formulated in Hypothesis 2). First, mediation requires a significant effect of the predictor variable (i.e., the interaction effect) on the outcome variable (i.e., acceptance of CCS) as well as a significant effect of the predictor variable on the proposed mediator(s). Both these requirements were met, as indicated by the results reported above. Mediation further requires a significant association between the proposed mediator(s) and the outcome variable after controlling for the independent variables and their interaction. Whereas perceived magnitude of benefits associated with CCS was significantly related to acceptance of CCS ( $\beta = .64, p < .001$ ), perceived magnitude of the risks was not ( $\beta = -.09, p > .43$ ). Note that the zero-order correlation between risk judgments and acceptance of CCS was not significant as well ( $r = -.18, ns$ ). As such, only perceived benefits can potentially mediate the Competence-based Trust by Organizational Position interaction on people's acceptance of CCS. Finally, mediation requires a significant reduction of the direct effect on acceptance of CCS after including perceived magnitude of benefits as a mediator in the equation. Consistent with the mediation model, the interaction effect dropped to nonsignificance after introduction of perceived benefits in the equation ( $\beta = .23, p > .17$ ). A Sobel test (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002; Sobel, 1982) confirmed that the reduction of the direct effect was significant ( $z = 4.03, p < .001$ ), indicating mediation. Hence, mediation analysis supported the causal chain account of trust with perceived magnitude of benefits as a mediator (the second element in the chain), but not with perceived magnitude of risks as a mediator.<sup>5</sup>

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<sup>5</sup> Preacher and colleagues (Preacher, Rucker, & Hayes, 2007) recently launched an alternative method (using bootstrapping) to test for mediation when two independent variables interact to influence the proposed mediator, as is the case in our study. We also used this method of analysis and found that when competence-based trust was high, the conditional indirect effect of organizational position on acceptance of CCS through perceived benefits was significant, because the 95% confidence interval (0.57; 1.46) did not include zero (0). When competence-based trust was low, however, the conditional indirect effect was not significant, because the 95% confidence interval (-0.66; 0.12) did include zero (0). These results provide additional support for the mediation model.

## **Discussion**

Study 2.1 has focused on the impact of competence-based trust in (and the position of) an organization involved in CCS decision making on people's risk and benefit perceptions and their acceptance of CCS. Results confirmed our reasoning about the higher diagnostic value of high competence-based trust relative to low competence-based trust: People's perceptions of the magnitude of risks and benefits as well as their acceptance of CCS were influenced by the organizational position in the case of high competence-based trust, but not in the case of low competence-based trust. Results also largely supported the causal chain account of trust, although perceptions of risks did not affect people's acceptance of CCS.

## **Study 2.2**

The aim of Study 2.2 was to examine our predictions regarding the effects of *integrity-based trust*. We hypothesized people to *run counter to* rather than to go along with the organizational position in the case of low integrity-based trust, while effects of the organizational position would be less pronounced in the case of high integrity-based trust (Hypothesis 3). In accordance with the causal chain model, we further hypothesized that perceptions of risks and benefits would mediate the relationship between integrity-based trust and the organizational position on the one hand, and people's acceptance of CCS on the other (Hypothesis 4). We used an experimental design that paralleled that of Study 2.1 to test these hypotheses, with the only difference that participants in Study 2.2 were informed about organizational integrity (in terms of honesty and concern) instead of organizational competence as in Study 2.1.

## **Method**

### **Participants and design**

The sample consisted of 75 undergraduate students from Leiden University (36 male and 39 female). These participants were randomly allocated to one of the four experimental conditions of the 2 (integrity-based trust: high vs. low) by 2 (organizational position regarding CCS implementation: pro vs. con) between-subjects factorial design.

### Procedure

The procedure of Study 2.2 largely followed that of Study 2.1. Participants first read a brief description about recently developed CCS technology, after which Organization A was introduced. This time, however, the information about Organization A contained the manipulation of organizational integrity. Participants in the high integrity-based trust condition read:

“Organization A is known as rather *honest*. In the past, the organization turned out *to offer* objective information at all times, *in spite of* the organizational interests. Furthermore, the organization has recently been proclaimed to be one of the *most* reliable organizations by the Board of Journalism. According to the Board’s report, one of the reasons for this proclamation was the organization’s virtually *constant* willingness to be open about their activities and to answer critical questions. Furthermore, information offered by the organization has hardly ever been misleading.”

Participants in the low integrity-based trust condition read:

“Organization A is known as rather *dishonest*. In the past, the organization turned out *not to offer* objective information at all times, *dependent on* the organizational interests. Furthermore, the organization has recently been proclaimed to be one of the *least* reliable organizations by the Board of Journalism. According to the Board’s report, one of the reasons for this proclamation was the organization’s *seldom* willingness to be open about their activities and to answer critical questions. Furthermore, information offered by the organization has *often* been misleading.” (italics added to highlight the differences between the two texts).

Next, we manipulated the position of Organization A regarding CCS, after which participants read the risks and benefits associated with CCS that the organization referred to. Finally, participants completed the questionnaire that included the dependent variables (acceptance of CCS,  $\alpha = .89$ ; perceived

magnitude of risks,  $\alpha = .73$ ; perceived magnitude of benefits,  $\alpha = .83$ ) and the manipulation checks (trust,  $\alpha = .97$ ; organizational position).

## **Results**

### **Manipulation checks**

We performed an ANOVA with organizational integrity and organizational position as independent variables and trust in the organization as dependent variable. This analysis revealed a strong main effect for organizational integrity only,  $F(1, 71) = 65.83, p < .001, \eta^2 = .48$ . As intended, participants in the high-integrity condition ( $M = 5.11, SD = 0.87$ ) trusted the organization more than participants in the low-integrity condition ( $M = 3.05, SD = 1.24$ ). Thus, we successfully manipulated integrity-based trust in Organization A.

With regard to the organizational-position manipulation, all participants in the pro-CCS condition correctly answered that Organization A was a proponent of CCS implementation, whereas all participants in the con-CCS condition correctly answered that Organization A was an opponent of CCS implementation.

### **Acceptance of CCS**

We conducted an ANOVA with integrity-based trust (high vs. low) and organizational position (pro vs. con) as independent variables and acceptance of CCS as dependent variable. This analysis revealed the predicted Integrity-based Trust by Organizational Position interaction,  $F(1, 71) = 9.56, p < .01, \eta^2 = .12$ . No main effects were observed. Additional simple main effect analyses revealed that, in the case of low integrity-based trust, participants accepted CCS more when the organization was an opponent ( $M = 4.72, SD = 1.10$ ) compared to a proponent of CCS ( $M = 3.59, SD = 1.31$ ),  $F(1, 72) = 8.07, p < .01$ . As expected, there was no reliable effect of organizational position on participants' acceptance of CCS in the case of high integrity-based trust,  $F(1, 72) = 2.77, p = .10$ , although participants tended to accept CCS to a greater extent when the organization was a proponent ( $M = 4.78, SD = 1.23$ ) compared to an opponent of CCS implementation ( $M = 4.11, SD = 1.39$ ). These results support Hypothesis 3, which stated that people would run counter to the organizational position in the case of low integrity-based trust, while effects of the organizational position would be less pronounced in the case of high integrity-based trust.

### **Perceived magnitude of risks and benefits**

We performed ANOVA to test whether integrity-based trust and organizational position affected perceptions of the risks and benefits communicated by the organization. With regard to perceived magnitude of risks, the analysis revealed a main effect of organizational position only,  $F(1, 69) = 4.27, p < .05$ . Surprisingly, participants who read that the organization was a proponent of CCS judged the risks associated with CCS to be somewhat higher ( $M = 4.87, SD = 0.92$ ) than participants who read that the organization was an opponent of CCS ( $M = 4.36, SD = 1.21$ ), regardless of integrity-based trust. This result is inconsistent with the causal chain account, on the basis of which we predicted to find a significant Integrity-based Trust by Organization Position interaction.

With regard to perceived magnitude of benefits associated with CCS, no reliable main effects were observed, but the Integrity-based Trust by Organizational Position interaction was marginally significant,  $F(1, 71) = 2.77, p = .10, \eta^2 = .04$ . The pattern of means was in line with predictions though, in that participants tended to run counter to the position of an untrustworthy organization.

### **Mediation analysis**

We used the stepwise procedure recommended by Baron and Kenny (1986) to test whether perceptions of the magnitude of benefits mediated the Integrity-based Trust by Organizational Position interaction on acceptance of CCS (Hypothesis 4). As reported above, we found the Integrity-based Trust by Organizational Position interaction effect on perceived magnitude of the benefits (i.e., the proposed mediator), although it only reached marginal statistical significance ( $\beta = .34, p = .10$ ). We entered the predictor variables and their interaction together with perceived benefits in a regression analysis with acceptance of CCS as the outcome variable. Although we obtained the required effect of the proposed mediator on acceptance of CCS ( $\beta = .65, p < .001$ ), the direct effect of Integrity-based Trust by Organization Position on acceptance remained significant ( $\beta = .38, p < .02$ ) and was not significantly reduced (Sobel  $z = 1.63, p = .10$ ).<sup>6</sup> We disregarded perceived risks as a potential mediating variable in this study because we did not find the required interaction effect. As such, we conclude that the effect of integrity-based

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<sup>6</sup> The bootstrapping procedure recommended by Preacher and colleagues (2007) confirmed these results: When integrity-based trust was low, the conditional indirect effect of organizational position on acceptance of CCS through perceived benefits was not significant ( $p = .13$ ) because the 95% confidence interval (-1.00; 0.09) included zero (0), while the same holds true for high integrity-based trust ( $p = .46$ ).

trust in interaction with organizational position on acceptance of CCS was neither mediated by the perceived magnitude of risks nor by the perceived magnitude of benefits.

### **Discussion**

Study 2.2 has focused on the impact of integrity-based trust in (and the position of) an organization involved in decision making about CCS on people's risk and benefit perceptions and their acceptance of CCS. In line with predictions, people ran counter to the organizational position in the case of integrity-based trust, while the effect of organizational position on acceptance of CCS was only marginal in the case of high integrity-based trust. We did not find evidence for the causal chain model's prediction that perceived risks and benefits mediated the relationship between integrity-based trust and organizational position on the one hand, and people's acceptance of CCS on the other.

### **General discussion**

Carbon dioxide capture and storage technology (CCS) is currently considered an important climate change mitigation option, but public acceptance will be crucial for successful implementation of this technology. On the basis of the causal model proposed by Siegrist (2000) we hypothesized people's trust in organizations involved in CCS decision making to affect their perceptions of the magnitude of risks and benefits associated with CCS, which in turn were expected to affect their acceptance of CCS. We extended the causal chain model by distinguishing between competence-based trust in organizations (i.e., trust based on organizational experience and expertise) and integrity-based trust in organizations (i.e., trust based on organizational honesty and concern). Moreover, we tested the causal chain account of trust for both these types of trust by means of experimental designs, thereby complementing previous work that used correlational data to test this model.

Our research demonstrates the importance of public trust in CCS stakeholders by showing that competence-based trust and integrity-based trust in organizations affect people's acceptance of CCS differently. Study 2.1 showed that people's judgments about the magnitude of risks and benefits as well as their acceptance of CCS were affected by the organizational position only in the case of high competence-based trust. That is, when competence-based trust was high,



people followed the organizational position in that they accepted CCS to a greater extent when the organization was a proponent rather than an opponent of CCS. Study 2.2 further supported our reasoning by showing that reversed effects occur in the case of integrity-based trust: Organizational position reliably affected people's responses only when integrity-based trust was low. In this case, that is, people ran counter to the organizational position and became more negative about CCS when the organization was a proponent compared to an opponent of CCS. These studies support our reasoning based on the information asymmetry principle in ability and integrity judgments.

The current experimental research offers support for the causal chain account of trust, but this was only the case for competence-based trust. As predicted, perceived benefits (but not perceived risks) mediated the interaction effect of competence-based trust and organizational position on people's acceptance of CCS. In the case of integrity-based trust, however, people seemed to arrive at their attitudes toward CCS through a different process. Consistent with Ajzen (2001) who noted that attitudes can either be cognition-based or emotion-based, we argue that competence-based trust may have activated a cognitive response mode that is relevant for judging the magnitude of prespecified risks and benefits (which is a cognitive task). Accordingly, people's acceptance of CCS can be considered the result of cognitive judgments (i.e., perceived risks and benefits) in the case of competence-based trust.

Integrity-based trust, on the other hand, may have activated an emotional response mode that is less likely to affect cognitive judgments about risks and benefits. Maybe people's level of acceptance of CCS can be considered a more immediate response on the basis of emotions activated by integrity-based trust, using judgments of benefits as a way to retrospectively justify their own position about CCS. People may have reasoned like: "I do not trust this organization. Because it is a proponent of CCS, I oppose its position and will reject CCS because...the benefits of CCS are not that great after all."<sup>7</sup> Future research may

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<sup>7</sup> Baron and Kenny's (1986) procedure revealed support for this reasoning. The marginal Integrity-based Trust by Organizational Position interaction on perceived benefits (i.e., the outcome variable) dropped to nonsignificance ( $\beta = -.09$ ,  $p = .60$ ) when people's acceptance of CCS (i.e., the newly proposed mediator) was included in the analysis. The reduction of the direct effect was significant, Sobel  $z = 2.87$ ,  $p < .01$ , indicating mediation. Moreover, tests of the conditional indirect effects (Preacher et al., 2007) showed that acceptance of CCS mediated the effect of organizational position on perceived magnitude of the benefits in the case of low integrity-based trust (95% confidence interval: -1.27; -0.22;  $p < .01$ ), but

more explicitly test the validity of this post hoc explanation, for example by also assessing the emotions that people experience in addition to their more cognitive judgments about risk and benefits.

The differences observed in the current studies between competence-based and integrity-based trust yield an interesting addition to the debate about the most accurate order of variables related to public acceptance of new technologies and hazardous activities (i.e., trust in organizations, perceived risks, and perceived benefits). On the one hand, our research supports the (cognitive) causal chain account for competence-based trust, but it also suggests that alternative (more emotion-based) processes may play a role in the case of integrity-based trust. The processes that we propose (i.e., justification of one's willingness to accept CCS by means of judgments about benefits) resembles the *associationist view* of trust (Eiser et al., 2002; Poortinga & Pidgeon, 2005) in that in this view perceptions of the magnitude of benefits are also considered to be the result rather than the cause of a general attitude toward CCS. Accordingly, distinguishing between competence-based and integrity-based trust may help to resolve the debate between the two competing theoretical accounts of trust. Both accounts may be valid, but for different forms of trust.

The current results suggest that the perceived benefits dominate people's level of acceptance of CCS implementation, regardless of the potential downsides. Trust affected people's risk perceptions in Study 2.1, but in both studies perceived risks were less relevant to people's acceptance of CCS. Nevertheless, by no means do we claim that people's perceptions of risks have no predictive value for their acceptance of CCS. After all, we cannot rule out the possibility that the results regarding the marginal role of risk perceptions in our studies can be attributed to, for example, specific characteristic of the risks presented (e.g., lack of catastrophic potential) or the fact that we had participants judge prespecified risk (rather than their own intuitive thoughts about potential risks). Note, however, that results of the current research are in line with previous research suggesting that public acceptance of new technologies (including CCS) more strongly relates to perceived benefits than to perceived risks (Siegrist, 2000; Tokushige et al., 2007). Identifying the conditions under which perceptions of benefits outweigh the importance of

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not in the case of high integrity-based trust (95% confidence interval: -0.12; 0.99;  $p = .14$ ). These results suggest that people directly display negative reactions to organizational positions when integrity-based trust is low, and may use judgments of the magnitude of benefits associated with CCS to legitimize their negative reactions.

perceived risks or vice versa is an issue to address in future research. For example, an interesting possibility for future on-site research is to examine whether risk perceptions may be a more potent determinant of acceptance of CCS among residents living nearby a storage site, while benefits associated with CCS may be a key factor for acceptance of those residing at a larger distance.

All in all, our research highlights the role of public trust in CCS stakeholders in the process of creating public acceptance of CCS. Accordingly, CCS is promising as a strategy to achieve climate change mitigation, but whether or not it will actually be employed does not solely depend on specific characteristics of this technology but on characteristics of the organizations involved as well.