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## Playing it safe: Negotiators avoid uncertainty and reach safer, but less integrative agreements<sup>☆</sup>

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## ABSTRACT

Social-interactive conflict management processes inherently involve uncertainties about the exact outcomes that agreements may yield. However, two literature reviews show that irrespective of the inherent uncertainty of most real-world social decision-making contexts, experimental negotiation studies have traditionally relied on certain outcome scenarios so that it remains unknown whether and how outcome uncertainty affects interactive logrolling and therefore agreement quality. In contrast, we propose and test two competing hypotheses on how outcome uncertainty may affect social-interactive joint decision-making. On the one hand, the Value-Insight Hypothesis suggests that focusing on the value component of uncertain outcomes highlights priority differences between conflict parties, thereby facilitating parties' interactive exploration of integrative priority-based trade-offs. On the other hand, the Uncertainty-Avoidance Hypothesis argues that focusing on the risk component of uncertain outcomes leads to mutual uncertainty-avoidant trade-offs that hinder parties to explore integrative priority-based trade-offs. We introduce novel social decision-making paradigms to systematically test these competing hypotheses in a causal chain design. Specifically, across three pre-registered ( $N = 502$ ) interactive negotiation studies, we find that in line with the Uncertainty-Avoidance Hypothesis parties' sensitivity to explore priority-differences is reduced under uncertainty. Across different operationalizations of outcome uncertainty parties reach less integrative agreements for uncertain compared to certain outcomes. In fact, parties reached more compromising agreements under uncertainty irrespective of varying levels and ranges of risks (Study 2). Beyond uncertainty-avoidance, parties reached lower-quality agreements under uncertainty even in contexts in which no mutual trade-offs allowed them to reduce or avoid uncertainty (Study 3).

Many personal, organizational, and political decisions are not made in isolation but rather in a social-interactive context that requires decision-makers to navigate their diverging preferences (De Dreu et al., 2007; Gelfand et al., 2011). For example, in negotiations, resolving conflicting preferences and reaching high-quality agreements requires negotiation parties to jointly explore who prioritizes which negotiation issues. Each party prioritizes those issues that provide greater profits for themselves over less profitable issues. Importantly, each party typically has incomplete information about what the other side prioritizes. However, if parties are able to jointly uncover who prioritizes which negotiation issues, they can trade-off what they value less for what they value more (i.e., integrative trade-offs). Thus, parties can exploit their

priority-differences across conflict issues and reach high-quality agreements when they make concessions on lower-priority issues in exchange for concessions from their counterpart on higher-priority issues (i.e., logrolling). As a result, the achieved integrative agreements improve the outcomes for all parties involved (Brett & Thompson, 2016; Movius, 2008). Crucially, such social decision-making processes are often complicated by an inherent uncertainty about the consequences of agreements (Bottom, 1998; Jang et al., 2018). For instance, parties have to negotiate on future price developments (e.g., Heydenbluth et al., 2025; Stolberg & Robbins, 2022), risky financial investments (e.g., Gallina, 2021), delayed resource use (e.g., Trötschel et al., 2022; van Treek et al., 2023), or sustainability policies (e.g., Barrett &

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Dannenberg, 2012; Majer et al., 2026) for which the exact outcomes can only be estimated. Thus, decision-makers are often challenged to explore how they can systematically logroll concessions in line with their priority-differences in order to reach mutually beneficial agreements even though the exact outcomes of agreements are uncertain<sup>1</sup> and only materialize with a given risk.

While the pivotal role of (outcome) uncertainty for interactive decision-making processes has been acknowledged (e.g., De Dreu et al., 2007; Jang et al., 2018; Schauer et al., 2023), systematic experimental evidence remains limited (e.g., Bottom, 1998; Essa et al., 2018). In fact, a broad systematic literature review across 6608 articles published between 1930 and 2025, as well as a systematic re-analysis of 581 integrative negotiation experiments that we conducted for this study (see Warsitzka et al., 2024), revealed only four studies that examined the effects of outcome uncertainty on parties' joint logrolling.

Outcome uncertainty, however, provides decision-makers with two components of information: (1) the *value* of choosing a specific agreement option, and (2) its associated *risk* of success (e.g., a value of \$20 and risk level of 70%). Whenever decision-makers are required to process multiple pieces of information, their *primary* focus on one of the information pieces may have a strong influence on their decision behavior (e.g., framing: Majer et al., 2020; Schaerer et al., 2020; Trötschel et al., 2015; endowment effect: Morewedge & Giblin, 2015). Similarly, depending on whether negotiation parties focus primarily on the value versus risk component of uncertain outcomes, two competing hypotheses can be derived about whether uncertainty facilitates or hinders the joint logrolling process that allows parties to reach high-quality integrative agreements.

On the one hand, ample behavioral decision-making research finds that the more accurate parties construe their conflict with a counterpart, the greater their ability to detect priority-differences and logroll (e.g., Bazerman & Carroll, 1987; Moran & Ritov, 2007; Warsitzka et al., 2022). In line with these findings, a primary focus on the *value* component of uncertain outcomes would predict a greater ability of parties to logroll in contexts of uncertain compared to certain outcomes (Value-Insight Hypothesis). Specifically, the greater the differences in the value component of parties' outcomes, the easier it may be for parties to discover that they prioritize negotiation issues differently (i.e., they provide different profits). When comparing contexts of certainty and uncertainty (with the same expected value), the difference between parties' value components of high- versus low-priority issues are by definition greater under uncertainty compared to certainty.<sup>2</sup>

On the other hand, a primary focus on the *risk* component predicts that outcome uncertainty may hinder parties' ability to logroll (Uncertainty-Avoidance Hypothesis). To logroll, parties must interactively explore trade-offs between lower- and higher-priority issues. Focusing on the risk component of uncertain outcomes may, indeed, alter negotiators' mutual trade-off behavior towards lower-quality compromise agreements that reduce both parties' uncertainties (e.g., uncertainty avoidance: Fox et al., 2015; Tversky & Kahneman, 1992).

These opposing theoretical predictions require an empirical investigation of how outcome uncertainty affects parties' logrolling and thereby their ability to reach integrative agreements. From a practical perspective, such empirical understanding of the effects of outcome uncertainty as a fundamental characteristic of social decision-making environments is key for the applicability of our field's findings (Boothby et al., 2023). In order to test whether outcome uncertainty facilitates or hinders parties' logrolling, we introduce a novel experimental approach (Minson et al., 2023). Specifically, across three pre-registered, social-interactive experiments ( $N = 502$ ), we systematically

tested the two alternative predictions that stem from focusing primarily on the value (i.e., Value-Insight) versus risk (i.e., Uncertainty-Avoidance) component of uncertain outcomes. In a first study, we investigated the basic effect of outcome uncertainty on parties' agreement quality. Study 2 served to generalize the uncertainty effect across diverse levels of risk and test whether outcome uncertainty focuses parties towards the value versus risk component. Finally, in Study 3, we directly manipulated the proposed underlying mechanism of parties' primary focus on either uncertain outcomes' values versus risks to test how differing foci affect parties' logrolling and their joint outcomes.

Our research extends the current understanding of social decision-making processes in three critical ways: (1) Unlike previous social decision-making studies that either focused on certainty (e.g., Burns et al., 2023; Majer, Zhang, et al., 2022; Pruitt & Lewis, 1975) or kept outcome uncertainty constant (e.g., Bottom, 1998; Shogren, 1992), we systematically compare the interactive process of logrolling across certain versus uncertain outcomes. This comprehensive approach allows us to empirically test two competing theoretical predictions on whether the exploration of priority-differences between parties is facilitated or hindered by outcome uncertainty. (2) From the lens of decision science, we provide a novel empirical account on how decision-makers *jointly* decide upon which risks to take and which to avoid. Thus, we highlight that uncertainty has unique effects in social-interactive decision-making contexts. (3) From an applied perspective, we aim at increasing the external validity of experimental social decision-making studies (Boothby et al., 2023) by focusing on outcome uncertainty as a real-world decision characteristic (Gallina, 2021; IPCC, 2022). Our findings may therefore offer valuable insights for effectively managing social conflict under uncertainty and pave the way for the development of evidence-based interventions.

## 1. Negotiations as a social decision-making process under outcome uncertainty

Social conflict between parties frequently requires the joint exploration of mutually acceptable agreements (De Dreu et al., 2007; Gelfand et al., 2011; Gentry et al., 2008). Importantly, most of the time, parties need to reach agreements on issues of *uncertain* nature (e.g., Bottom, 1998; Jang et al., 2018): profit margins are susceptible to market changes, investment decisions provide risky returns, and the successful implementation of employee satisfaction or sustainability measures is bound by unpredictable environmental determinants. Hence, while parties generally face a variety of different forms of uncertainty (Bottom, 1998; Schauer et al., 2023), it is the natural *uncertainty of outcomes* that we are concerned with here. Irrespective of parties' expertise, consequences of their actions are not 100% certain, yet they need to interactively agree upon one explicit course of action.

### 1.1. Interactive exploration of integrative agreements

In most real-world contexts social conflict is not a zero-sum situation in which one party's gains imply equal losses for another party. Instead decision-makers may explore opportunities to craft integrative, win-win agreements (De Dreu et al., 2007; Gelfand et al., 2011; Walton & McKersie, 1965). These structurally-provided integrative opportunities can be exploited by the parties through the joint process of *logrolling*: negotiation parties do not simply divide a fixed sum of profit between themselves, but rather explore integrative agreement options that create more profit to each party compared to a mere fifty-fifty compromise (e.g., Pruitt & Lewis, 1975; Thompson, 2015; Walton & McKersie, 1965).

Fig. 1 provides an example of such an integrative conflict of interest (De Dreu et al., 2007; Pruitt & Lewis, 1975): two negotiation parties negotiate about two negotiation issues that offer three agreement options each. While party A prefers option 'i' for both issues, party B prefers option 'iii' for both issues. Moreover, while party A prioritizes Issue 1, party B prioritizes Issue 2.

<sup>1</sup> The term *uncertain* is not used in its mathematical sense (Ellsberg, 1961), but as an overarching concept denoting outcomes that are non-certain.

<sup>2</sup> To be of equal expected value compared to certain outcomes, uncertain outcomes' value components must increase.

option	Party A		Party B	
	Issue 1 (high-priority)	Issue 2 (low-priority)	Issue 1 (low-priority)	Issue 2 (high-priority)
i	40	20	4	8
ii	24	12	12	24
iii	8	4	20	40

Fig. 1. Visualization of compromising and integrative agreements.

Note. Exemplary payoff charts of a two-party integrative negotiation. Both negotiation issues provide three agreement options. Each party only receives information on their own payoffs. The compromise agreement (i.e., dashed blue frames) leaves each party with a profit of 36. However, parties may explore and exploit their structural priority-differences, make priority-based trade-offs and thereby jointly reach an integrative agreement: agreeing on option 'i' for Issue 1 in return for agreeing on option 'iii' for Issue 2, provides each party with a profit of 44 (i.e., solid green frames).

At the level of negotiation behaviors, a compromising strategy would ignore parties' priorities and lead negotiators to meet halfway: they agree on the middle option across issues and hence achieve a sub-optimal compromise agreement. However crucially, although parties have incomplete information about their counterpart's payoffs at the start of the negotiation, parties may *interactively* explore that they prioritize the negotiation issues differently. Such an integrative logrolling strategy would lead parties to make priority-based trade-offs and maximize the outcome for both parties (e.g., Majer, Schweinsberg, et al., 2022; Murnighan et al., 1999; Raiffa, 1982). Specifically, whenever both parties give in on their lower-priority issue(s) that provide lower profits to receive greater profits on their higher-priority issue(s), they end up with an improved agreement compared to a compromise and therefore jointly reach an integrative agreement. How and which trade-offs parties exchange therefore determines the quality of agreements.

In the specific example of Fig. 1, the integrative logrolling strategy would be to agree upon option 'i' for Issue 1 and option 'iii' for Issue 2. That way both negotiators would end up with an outcome (i.e.,  $40 + 4 = 44$ ) that is higher than the compromise agreement (i.e.,  $24 + 12 = 36$ ). In contexts that provide more than three agreement options per negotiation issue, negotiators may logroll to different degrees depending on whether they fully explore their priority differences or only partly.

To illustrate how an integrative versus compromising negotiation strategy emerges in an actual negotiation sequence, we provide two transcribed conversation snippets from two different negotiations from Study 1. Compromising strategies lead negotiators to meet halfway between their preferred option on each individual negotiation issue. Such a strategy is reflected in the following conversation example: Party A: "For issue X you want option E, right?" – Party B responds with a concession: "Yes, but I would be willing to move to option D. How would this be for you?" – Party A suggests a compromise: "That would still be quite bad for me. I originally wanted option B. [hesitation] Option C would be okay for me too. Could you do option C?". In contrast, integrative strategies are characterized by exploiting priority differences between multiple negotiation issues and hence trading-off what they value less for what they value more. Integrative logrolling is reflected in the following conversational pattern: Party A: "For a couple of issues I cannot concede, they must be a given. For example, issue X, I need a good outcome for issue X. I have to get option E, otherwise I can't be economically profitable." – Party B responds with an integrative logrolling strategy of exchanging priority-based trade-offs: "So for both issue X and issue Y you want option E, correct? My proposal would be that you agree upon option A for issue Y, if I agree upon option E for issue X."

### 1.2. Interactive exploration of integrative agreements under uncertainty

Social psychology has a long tradition of investigating whether and how parties reach integrative agreements (e.g., Brett & Thompson, 2016; Jang et al., 2018; Moran & Ritov, 2007). However, providing parties in experimental negotiation tasks with clear-cut, definite

outcomes and payoff structures stands in stark contrast to practitioners' experience (e.g., Gallina, 2021; Intergovernmental Panel on Climate Change, 2022) and theoretical consensus that "negotiators face and manage fuzzy, ambiguous, and messy situations" (De Dreu et al., 2007, p. 611). This mismatch between the kinds of contexts typically investigated in experiments (i.e., certain negotiation outcomes) and those that practitioners face (i.e., uncertain negotiation outcomes), limits the scope, relevance, and applicability of our fields' findings (Boothby et al., 2023).

Indeed, two systematic literature reviews we conducted to assess this mismatch (Schweinsberg et al., 2023), revealed that the experimental negotiation literature has almost exclusively relied on investigations of integrative agreements using negotiation paradigms that assume outcome certainty. In particular, we re-analyzed data from a recent meta-analysis on 581 integrative negotiation studies from 485 articles (Warsitzka et al., 2024) as well as conducted a Scopus-based literature review screening 6608 articles published between 1930 and 2025 (for details see the OSM: <https://doi.org/10.17605/OSF.IO/SU4A8>). Across both reviews, we only identified four experimental investigations (i.e., Arunachalam et al., 1998; Bottom, 1998; Essa et al., 2018; Shogren, 1992) into the effects of outcome uncertainty on parties' ability to reach integrative agreements.

For instance, in contexts of unequal power, Shogren (1992) found that parties reach less mutually advantageous agreements when negotiating about risky lottery choices. Bottom (1998) investigated the difference between gain and loss frames on parties' logrolling under uncertainty, while Essa et al. (2018) investigated how one risky negotiation issue affected parties' logrolling on different certain outcome issues. Arunachalam et al. (1998) studied not the outcome uncertainty of the negotiation parties, but how a mediator's uncertainty affected logrolling between parties. Hence, we conclude that none of the reviewed studies directly investigated whether parties' joint process of exploring integrative agreements differs depending on whether their outcomes were certain versus uncertain. The great majority of studies did not implement (outcome) uncertainty at all, despite its undisputable real-world relevance.

## 2. Competing hypotheses for logrolling under uncertainty

When confronted with uncertain outcomes, (social) decision-makers face two components of information (instead of just one profit describing information component): a *value* for a specific agreement option (e.g., \$20) and a *risk* level of successful materialization of that outcome (e.g., 70%). When decision-makers face multiple components of information, their primary focus on one component or another can shape their perception and behavior. For example, the endowment effect can be understood in part as a biased information processing phenomenon, with buyers and sellers focusing on different aspects of their transaction (Morewedge & Giblin, 2015). In joint decision-making contexts the procedural framing of proposals as offers versus requests

has been shown to alter parties' primary focus on the resources to be lost versus gained, ultimately affecting their joint negotiation behavior (Majer et al., 2020; Trötschel et al., 2015).

Similarly, decisions under uncertainty allow two different foci, one on the *value* and another on the *risk* component. In fact, the literature on individual decision-making under uncertainty has uncovered multiple determinants of individuals' willingness to take higher risks for greater outcomes. Individuals who make particularly risky choices commonly score high on measures such as sensation seeking (e.g., Bevins, 2001; Qianlan et al., 2025) and reward sensitivity (e.g., Penolazzi et al., 2012; Scott-Parker & Weston, 2017), indicating that their primary focus lays with the *value* component of their decision options. Lower value, risk-avoidant decisions on the other hand are commonly the result of a primary focus on the *risk* component (e.g., risk sensitivity; Charness et al., 2007; Christopoulos et al., 2009; Ruggeri et al., 2020; Tversky & Kahneman, 1992). Within joint decision-making contexts such as negotiations, parties may also primarily focus on the *value* versus *risk* component of uncertain outcomes. These different foci likely affect parties' ability to logroll and hence shape the quality of their final agreements. Empirically understanding whether and how parties' primary focus on uncertain outcomes' values versus risks becomes increasingly important when considering that different theoretical accounts predict opposing effects of outcome uncertainty on negotiators' agreement quality.

### 2.1. Facilitating logrolling: the Value-Insight Hypothesis

The behavioral decision-making perspective on negotiations revealed that an enhanced understanding of the social-interactive decision task facilitates logrolling (e.g., Bazerman & Carroll, 1987; Moran & Ritov, 2007; Warsitzka et al., 2022). Gaining a more thorough understanding of the differences between parties' own and their counterparts' interest structures facilitates the exchange of priority-based trade-offs, leading to more integrative agreements (Arnold & O'Connor, 2021; Geiger & Hüffmeier, 2020). These insights are, for instance, put into practice when negotiators are instructed to use an 'issue analysis' strategy, which directly aims at identifying logrolling opportunities between parties' priority differences (e.g., Siebert & Herbst, 2021).

Outcome uncertainty may, in fact, aid negotiators in gaining an understanding of each other's priority differences. When expected values (i.e.,  $\text{value} \times \text{risk}$ ) between outcome options remain constant, but uncertainty increases, the differences in payoff structure between parties are accentuated (see Fig. 2). For instance, while the value difference between the certain agreement option A = 80 and option B = 100 is 20 points, the value difference between risky agreement options with a 70% probability of realization is 29 points (i.e., option A =  $114 \times 70\%$  and option B =  $143 \times 70\%$ ). Divergent priority structures of parties' lower-versus higher-priority issues are therefore more easily discovered when the outcomes are uncertain compared to when they are certain. Parties who primarily focus on the *value* component of uncertain outcomes may therefore use the heightened visibility of priority differences to guide their exploration of trade-off opportunities (e.g., Warsitzka et al., 2022), which in turn facilitates the exchange of priority-based trade-offs (e.g., Arnold & O'Connor, 2021; Trötschel et al., 2011). In short, a focus on risky outcomes' values should aid parties to reach integrative agreements. Hence, in line with an exploratory approach, we define our first hypothesis:

**H1a (Value-Insight Hypothesis).** Negotiators will logroll *more* (i.e., reach *higher* joint outcomes) when the priority-structures of outcomes are accentuated by uncertainty compared to when the outcomes are certain.

### 2.2. Hindering logrolling: the Uncertainty-Avoidance Hypothesis

In an analysis of why international negotiations frequently fail,

Underdal (1983) highlights that "uncertainty tends to slow down the negotiation process and disturb the search for mutually advantageous solutions" (p. 187–188). Research on the motivational tendencies of decision-makers reveals that they avoid uncertainty and underscores that risk aversion can significantly hinder rational decision processes (e.g., Bottom, 1998; Essa et al., 2018; Hardisty & Pfeffer, 2017). This aversion can be rather extreme with decision-makers preferring zero-risk options despite the additional costs associated with such choices (Fox et al., 2015; Greiner, 2023; Kahneman & Tversky, 1979; Viscusi et al., 1987).

The exploration of integrative agreements requires parties to *not* concede on (objectively) highly valued negotiation issues and exchange mutual trade-offs on (objectively) lower valued negotiation issues. Negotiators who primarily focus on the *risk* component of uncertain outcomes may, however, be guided by a motivation to exchange trade-offs that reduce all parties' risks (see Fig. 2). In an attempt to achieve more certain (lower valued) outcomes, negotiators likely agree upon compromising trade-offs (i.e., meeting halfway for each negotiation issue) so that both parties are able to reduce their respective uncertainty. Mutual trade-offs that need to be made to explore priority-differences may not be made if these leave both parties with riskier outcomes. Hence, parties' focus on uncertain outcomes' risks likely results in mutual uncertainty-avoidant (compromising) trade-offs that hinder integrative logrolling.

**H1b (Uncertainty-Avoidance Hypothesis).** Negotiators will logroll *less* (i.e., reach *lower* joint outcomes) when the priority-structures of outcomes are accentuated by uncertainty compared to when the outcomes are certain.<sup>3</sup>

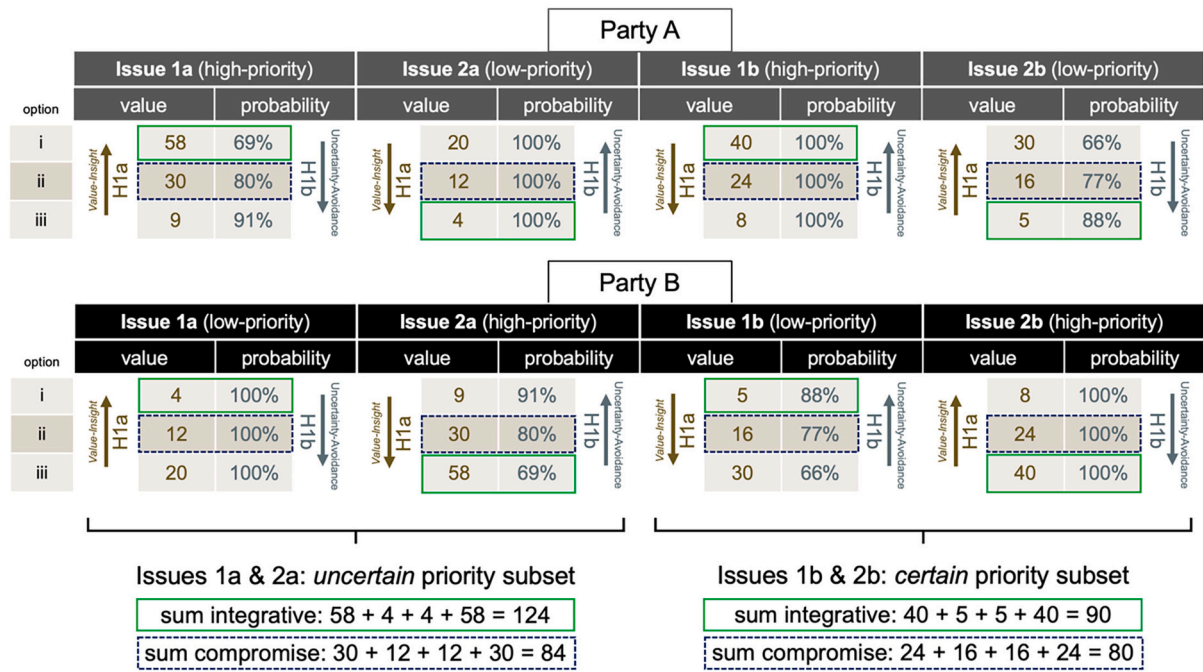
### 2.3. Generalizing the effect of outcome uncertainty on the exploration of integrative agreements

Parties' trade-off behavior may be sensitive to changes in *risk levels* of uncertain outcomes (e.g., Gurevich et al., 2009; Ruggeri et al., 2020). Specifically, uncertain outcomes can take many different forms ranging from outcomes with lower versus higher risks. Accordingly, when keeping the expected value of different uncertain outcomes equal, not only the risk component of these uncertain outcomes varies substantially (i.e., lower vs. higher risks of success) but naturally so does the value component (i.e., lower vs. higher values when successful): the higher the risk of an outcome, the larger its value component must be to keep the expected value constant. Moreover, a set of risky outcomes may vary in their range of risk levels. In some contexts, different agreement options may have rather similar risks (i.e., small range of uncertainties) while in others, they may vary more considerably (i.e., large range of uncertainties). Hence, uncertain outcomes are not a uniform factor but instead can vary in their overall *size* and *range* of risks.

From a *Value-Insight* perspective, a heightened difference in outcome values—either because of large sizes or ranges of outcome risks—accentuates priority differences between parties. When priority differences become more prominent, priority-based trade-offs (i.e., logrolling) should become more likely (e.g., Arnold & O'Connor, 2021; Geiger & Hüffmeier, 2020). Consequently, when parties primarily focus on the *value* component of uncertain outcomes, larger risks (H2a) and larger ranges of outcome risks (H3a) should improve their logrolling (i.e., *higher* joint outcomes) compared to smaller sized risks or smaller ranges of outcome risks.

However, from an *Uncertainty-Avoidance* perspective, the *risk* component of uncertain outcomes should influence parties' behavior

<sup>3</sup> The decision-making literature provides stronger support for H1b as compared to H1a. For Studies 1 and 2, we therefore pre-registered H1b only. However, we directly manipulated, tested, and pre-registered negotiators' focus on values versus risks in Study 3.



**Fig. 2.** Visualization of the Value-Insight (H1a) and Uncertainty-Avoidance (H1b) hypotheses based on a simplified payoff structure of Study 1. Note. Simplified illustration of the two-party conflict structure in Study 1: each agreement option is associated with a specific *value* and *probability* (i.e., risk). Issues 1a (2a) and 1b (2b) are equal in expected value and mirror the payoffs of Fig. 1. While for the left two issues (i.e., uncertain priority subset) the uncertain issues provide higher profits and are therefore of higher priority, for the right two issues (i.e., certain priority subset) the certain issues are of higher priority. The *Value-Insight Hypothesis* H1a argues that negotiators focus on the value component. Since the difference in value components between the integrative (i.e., solid green frames) and compromise agreements (i.e., dashed blue frames) is larger in the uncertain priority compared to the certain priority subset, exploring integrative logrolling opportunities is easier in the former compared to the latter case. The *Uncertainty-Avoidance Hypothesis* H1b argues that negotiators focus on the risk component, conceding based on uncertainty avoidance, thereby obstructing the possibility to logroll for the uncertain priority subset and guiding them towards logrolling for the certain priority subset.

more strongly. Specifically, the exact probabilities of potential outcomes play an important role for individuals' perception and behavior (Gurevich et al., 2009; Kahneman & Tversky, 1979; Ruggeri et al., 2020; Tversky & Kahneman, 1992). The attractiveness of gambles, for example, tends to be evaluated more strongly based on their associated risk as opposed to their payoff (Slovic et al., 2007). Hence, the salience of the uncertain character of outcomes likely influences uncertainty-avoidant trade-offs. The larger the size or range of outcome risks, the more salient uncertainty becomes, and the more uncertainty-avoidant (compromising) trade-offs are made. Thus, when parties primarily focus on the *risk* component of uncertain outcomes, larger risks (H2b) and larger ranges of risks (H3b<sup>4</sup>) should hinder parties' logrolling (i.e., lower joint outcomes) to a greater degree compared to smaller sized risks or smaller ranges of risks.

In Study 2 we explore these boundary conditions, investigating the moderating effect of parties' *risk sensitivity*. Specifically, we test whether parties are sensitive to changes in uncertain outcomes' *risk sizes* and *ranges*.

2.4. Present research

To test the two competing hypotheses on the effects of outcome uncertainty on parties' logrolling and hence their ability to reach

<sup>4</sup> In line with Hypothesis 1 and the results of Study 1, we pre-registered H2b and H3b only. In addition, we pre-registered an interaction effect of *risk size* and *range* as H4: since the differences between lower risks is likely to be perceived as greater compared to the same differences of percentage points between higher risks (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992), manipulating the range of uncertain outcome risks should have a greater effect for risks of lower compared to higher size.

integrative agreements, we conducted three pre-registered, a-priori powered, social-interactive negotiation experiments. In Study 1, we aimed at gaining a fundamental understanding of parties' mutual trade-off behaviors when confronted with certain versus uncertain outcomes. Our novel multi-issue negotiation paradigm included both *certain* and *uncertain outcomes* with the same expected value, allowing us to compare parties' logrolling depending on the level of certainty (Value-Insight H1a vs. Uncertainty-Avoidance H1b). Outcome uncertainty was operationalized as probabilistic outcomes which can "serve as a device for quantifying and communicating uncertainty encountered in the world" (Keren & Gerritsen, 1999, p. 150) and allowed us to keep negotiation scenarios equal based on expected value. The incentivized Study 2 was conducted to replicate and generalize our findings from Study 1, allowing us to investigate potential boundary conditions (i.e., risk sensitivity) that play a role when dealing with uncertain outcomes. Specifically, we varied parties uncertain outcomes' *risk sizes* (H2a & H2b) and *ranges* (H3a, H3b & H4). This allowed us to systematically compare mutual trade-off behaviors depending on objectively identical, yet subjectively different, uncertain outcomes. In addition, in Study 2 we tested whether uncertain outcomes made negotiators primarily focus on uncertain outcomes' *values* versus *risks*. Finally, in a third incentivized study, we completed our experimental causal chain design (Spencer et al., 2005) and manipulated the proposed underlying mechanism of outcome uncertainty effects. Particularly, we experimentally varied parties' focus on either uncertain outcomes' values (Value-Insight Hypothesis) versus risks (Uncertainty-Avoidance Hypothesis). Hence, Study 3 concludes with causal insights into the effects of different foci on parties' ability to logroll.

## 2.5. Open science and transparency

We report how we determined our sample sizes, all data exclusions, all manipulations, and all measures for all studies. To further ensure open science and transparency, we have pre-registered all three studies (Study 1: <https://doi.org/10.17605/OSF.IO/YQPGU>; Study 2: [https://aspredicted.org/JYV\\_SSD](https://aspredicted.org/JYV_SSD); Study 3: <https://doi.org/10.17605/OSF.IO/SU4A8>) and provide public access to our Online Supplementary Materials (OSM) which include study materials, data sets, syntaxes and further supplementary materials at the OSF (Study 1: <https://doi.org/10.17605/OSF.IO/RS3C8>; Study 2: <https://doi.org/10.17605/OSF.IO/YZ57E>; Study 3: <https://doi.org/10.17605/OSF.IO/SU4A8>).

## 3. Study 1: reaching integrative agreements for certain versus uncertain outcomes

The pre-registered Study 1 tested the competing hypotheses: the Value-Insight H1a predicts that parties make *more* priority-based trade-offs and thereby reach *higher* joint outcomes when confronted with uncertain compared to certain outcomes. In contrast, the Uncertainty-Avoidance H1b predicts that parties make *less* priority-based trade-offs and thereby reach *lower* joint outcomes when confronted with uncertain compared to certain outcomes.<sup>5</sup> We manipulated the structure of conflict parties' outcomes by varying between negotiators, within negotiation issues whether outcome uncertainty is present or not (i.e., the same issue had certain outcomes for one and uncertain outcomes for the other party, resulting in four certain and four uncertain outcome issues per party). Moreover, we varied within negotiation dyads whether the certain versus uncertain outcome issues provided higher profits and therefore needed to be prioritized in order to reach integrative agreements (i.e., priority location; see Fig. 4). This manipulation allowed us to maximize both the priority differences (potential effect based on Value-Insight H1a), as well as the risk differences (potential effect based on Uncertainty-Avoidance H1b) between parties. Due to the Covid-19 pandemic and closed laboratories at the time of data collection, the interactive, dyadic negotiation study was implemented online using a video conference tool and the experiment software Gorilla (<https://gorilla.sc/>).

### 3.1. Method and procedure

#### 3.1.1. Participants and design

Based on an a-priori power analysis (Faul et al., 2007) for a two-tailed difference in means effect with an effect size of  $d = 0.70$  and a power of  $1-\beta = 0.95$ , we pre-registered a sample size of 60 participants (30 dyads; see OSM for a G\*Power screenshot). To account for potential exclusions and participants missing their assigned time slot, we invited participants until we had collected our pre-registered sample size. All scheduled participants were tested, resulting in a total sample of 64 participants<sup>6</sup> (32 dyads;  $n_{\text{female}} = 39$ ,  $n_{\text{male}} = 25$ ;  $M_{\text{age}} = 23.44$ ,  $SD_{\text{age}} = 4.15$ ) with different academic majors (e.g., business administration, psychology). A sensitivity analysis indicated that 32 dyads would be sufficient to detect a minimum effect size of  $d = 0.66$  with  $\alpha = 0.05$  and power = 0.95 for a two-tailed difference in means effect. Participants either received course credit or €8 for their participation. The study followed a  $1 \times 2$  (priority location: certain vs. uncertain outcomes) within-subjects design meaning that all negotiation dyads faced both certain and uncertain outcome issues. Within each dyad, participants were randomly assigned one of two roles. The unit of analysis was the

<sup>5</sup> We have additionally pre-registered a moderation effect of multiple-issue offer use (Yao et al., 2021). The results are inconclusive and reported in the OSM.

<sup>6</sup> Fifty-six participants indicated being students, five employed, and three participants chose not to answer.

dyad.

#### 3.1.2. Procedure

Participants entered a video conference call in pairs of two or four. Experimenters verbally gave general standardized instructions about the study procedure. Participants then received an individual link to an external platform (<https://gorilla.sc/>) through which the consent form and all detailed instructions were provided. If four participants were present, pairs of two participants plus one experimenter were moved to a separate virtual room. Participants were explicitly instructed to have both, the video conference call (for the negotiation) and the experimental software (for the instructions and materials) open at all times.

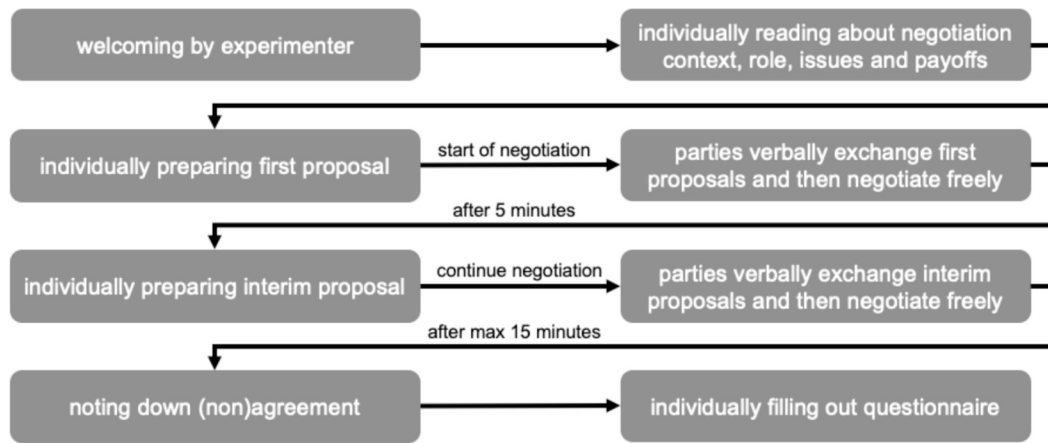
The study procedure can be seen in Fig. 3. In particular, participants first individually read about the negotiation context, the negotiation issues at stake, their particular goal in the negotiation (e.g., "It is your goal to negotiate a high profit for your company."), and the procedure of the negotiation. In addition, negotiators were provided with so-called 'negotiation overviews' that detailed which negotiation issues were at stake, what agreement options were possible and what their personal profit would be given each agreement option (i.e., payoff charts). Hence, participants had incomplete information and were only provided with information on their own payoffs, not about their counterpart's payoffs. Once both participants had familiarized themselves with their materials, the negotiation started with an exchange of their first proposals. Thereafter, participants were free to negotiate as they liked, typically exchanging information on which agreement options per negotiation issues they would like to agree upon. Trained experimenters were present at all times, monitoring participants' negotiation and clarifying potential questions about the task or materials. To assess an interim proposal, dyads were interrupted after five minutes of negotiating. The negotiation ended either when participants reached an agreement or when the negotiation time of 20 min was over. All negotiations were video recorded. Finally, upon finishing the negotiation, participants filled out a questionnaire and were debriefed. Payments were administered online. Overall, the study procedure took around one hour.

#### 3.1.3. Experimental manipulation and negotiation task

The instructions provided participants with the social-interactive decision context. In particular, participants were asked to assume the role as the owner of one of two agricultural companies. The local government had authorized eight new agricultural regions for growing regional vegetables. Participants had to negotiate with the owner of another agricultural company about the allocation of each of the eight regions. Five options on how to divide each region were available, with each company achieving their highest outcome when they receive as much of each region as possible. The instructions for both negotiators were identical in depth and informativeness with the exception of the so-called negotiation overview. The negotiation overview (see Appendix A) provided each negotiator with a payoff schedule, detailing how much profit they could expect to achieve with any specific option (Conflict Strength Coefficient based on Majer, Schweinsberg, et al., 2022: 0.71).

The experimental conditions of Study 1 were implemented within parties' payoff schedules. Specifically, to investigate the competing Value-Insight and Uncertainty-Avoidance Hypotheses, a study design based on the *high risk – high value* (or *low risk – low value*) principle was crafted. The design aimed at systematically differentiating between parties' ability to reach integrative agreements depending on their primary focus on either the value or risk component of agreement options. For this purpose, negotiation dyads were presented with eight negotiation issues, each offering either certain or uncertain agreement options. Crucially, the negotiation issues were structured so that a) one negotiation party faced certain, while the other faced uncertain agreement options (see Fig. 4); and b) two subsets of issues emerged (i.e., the within-subject factor priority location). For one subset, parties' high priority issues were certain and for the other subset uncertain.

According to the Value-Insight H1a, negotiation dyads should



**Fig. 3.** Visualization of the general study procedure. Note. Flowchart depicting the general study procedure of all three studies. Experimenters were present at all times monitoring both the individual preparation and joint interactive negotiation phases.

	Issue 1	Issue 2	Issue 3	Issue 4	Issue 5	Issue 6	Issue 7	Issue 8
Party A	<b>un-certain</b>	certain	<b>un-certain</b>	certain	<b>certain</b>	uncertain	<b>certain</b>	uncertain
Party B	certain	<b>un-certain</b>	certain	<b>un-certain</b>	uncertain	<b>certain</b>	uncertain	<b>certain</b>

uncertain priority subset
certain priority subset

**Fig. 4.** Study 1: structural overview of the negotiation task. Note. In Study 1, parties faced eight negotiation issues that provided certain versus uncertain profits. The priority-based trade-offs between parties are depicted in bold (i.e., indicating high priority issues). The first four (last four) negotiation issues depict the subset of issues for which negotiation parties' priorities laid with the uncertain (certain) outcome issues. Both subsets are fully symmetric.

primarily focus on the value components of the agreement alternatives. Value differences between parties are larger in the subset of issues with high priority uncertain issues, leading to an easier exploration of priority differences and greater joint outcomes compared to the subset of issues with high priority certain issues. In contrast, according to the *Uncertainty-Avoidance H1b*, the effect is reversed: negotiation parties should primarily focus on the risks of agreement alternatives, leading to uncertainty-avoidant, instead of priority-based trade-offs. These mutual uncertainty-avoidant trade-offs are detrimental for the uncertain but not the certain priority subset, leading to lower joint outcomes for the former compared to the latter subset.

3.1.4. *Dependent variables*

3.1.4.1. *Joint outcome.* The main dependent variable captures how much negotiators logrolled, meaning the joint outcome of negotiation dyads. We calculated negotiators' joint outcome separately for the uncertain and certain priority subsets. Specifically, we added up the individual outcomes of both parties per issues of a priority subset (i.e., based on Fig. 4, issues 1–4 for the uncertain and issues 5–8 for the certain priority subset). The profits for issues with risky outcomes were calculated using expected values. Both parties could achieve identical outcomes.

3.1.4.2. *Video ratings.* All negotiations were video recorded for exploratory analyses. A pre-registered rating schema was used to quantify negotiation behaviors. All ratings were made independently by two raters and differences between raters were clarified jointly. The rating schema and full exploratory analyses can be found in the OSM.

3.1.4.3. *Additional variables.* For exploratory purposes we assessed a

variety of additional variables in the post-questionnaire. Their exploratory findings can be found in the OSM.

3.2. *Results*

All analyses for Study 1, 2, and 3 were run using R version 4.5.0 (R Core Team, 2022). Across all studies all dyads reached an agreement.

3.2.1. *Joint outcome*

A two-sided paired *t*-test was conducted to test our competing hypotheses, with the Value-Insight H1a predicting that parties reach higher quality outcomes for the uncertain compared to the certain priority subset, and the Uncertainty-Avoidance H1b, predicting that parties reach higher quality outcomes for the certain compared to the uncertain priority subset. In line with our pre-registered Uncertainty-Avoidance H1b, negotiation dyads created higher joint outcomes for the *certain priority subset* ( $M_{\text{certain}} = 190.50, SD_{\text{certain}} = 9.30$ ), compared to the *uncertain priority subset* ( $M_{\text{uncertain}} = 170.13, SD_{\text{uncertain}} = 12.44$ ). This difference ( $M = 20.38, 95\% \text{ CI } [15.44, 25.31]$ ) was highly significant at  $t(31) = 8.42, p < .001 (d = 1.49)$ . In reference to the compromise (168 per subset) and fully integrative solution (200 per subset), the results indicate that parties logrolled less for uncertain compared to certain outcomes (see Fig. 5).

3.2.2. *Exploratory analyses*

We explored negotiators' behaviors by means of video recordings. Two findings were most striking: 1) we find that parties exchanged information on the importance of negotiation issues with a certain outcome significantly more often than information on negotiation issues with an uncertain outcome; yet 2) we also find that only information sharing about uncertain issues positively predicted joint outcomes while information sharing about certain issues did not. For the full analyses of

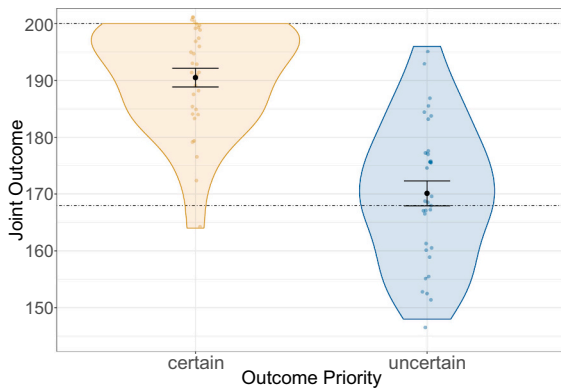


Fig. 5. Study 1: joint outcome by priority location.

Note. Fig. 5 shows the difference of parties' joint outcome split by outcome priority subset. The two dotted lines represent the compromise (at 168 points) and fully integrative (at 200 points) agreements. The error bars represent standard errors. Significantly higher joint outcomes were created for the certain compared to the uncertain priority subset.

our behavioral video recording analyses as well as further exploratory analyses visit the OSM.

### 3.3. Discussion

In line with our pre-registered Uncertainty-Avoidance H1b, we found that conflict parties logrolled less for uncertain priority issues than certain priority issues. Such lower logrolling for contexts in which high-priority issues are uncertain speaks for a primary focus on uncertain outcomes' risks and an exchange of mutual trade-offs based on uncertainty-avoidance instead of priority-differences. By focusing on uncertain outcomes' risks, parties exchanged trade-offs that allowed them to jointly achieve more certain (i.e., less risky), yet lower valued agreements.

Previous findings from related fields (e.g., Gurevich et al., 2009; Kahneman & Tversky, 1979; Ruggeri et al., 2020; Tversky & Kahneman, 1992) indicate that decision-makers are sensitive to different risk levels creating heterogeneous effects of outcome uncertainty. Hence, variations in risks likely act as boundary conditions for the effect of outcome uncertainty in social decision-making processes as well. By manipulating both the size and range of outcome risks in Study 2, we are able to test whether negotiation parties are risk sensitive when jointly reaching an agreement. Specifically, from a Value-Insight perspective, an increased perceptibility of value differences between parties due to larger risks or larger ranges of risks should facilitate negotiators' ability to logroll. From an Uncertainty-Avoidance perspective, larger (ranges of) risks increase the focus on outcome uncertainty, hindering parties from logrolling.

## 4. Study 2: the effects of different levels of outcome uncertainty & parties' value versus risk focus

The pre-registered Study 2 aimed at replicating the effect of outcome uncertainty on parties' ability to reach integrative agreements under various boundary conditions and using a more conservative operationalization of outcome uncertainty. Specifically, outcome uncertainty was manipulated not within issues (i.e., one party facing certain and the other uncertain outcomes per issue), but within dyads (i.e., both parties facing certain or uncertain outcomes per issue; see Fig. 6). This approach aligns with classical work in the experimental negotiation literature (i.e., manipulation on a dyadic level: e.g., Beersma & Dreu, 1999; De Dreu et al., 1998; Pruitt & Lewis, 1975; Trötschel et al., 2013), providing a more conservative test of our hypotheses and ensuring that the findings of Study 1 were not dependent on the specific operationalization of

outcome uncertainty. In addition, we varied the level of risk of the uncertain outcomes (between dyads), while maintaining identical objective expected values.<sup>7</sup> This procedure allowed us to test our competing hypotheses of Value-Insight and Uncertainty-Avoidance under diverse levels of uncertainty.<sup>8</sup> In particular, we predicted that 1) based on the Uncertainty-Avoidance Hypothesis (H2b) parties would reach *higher* joint outcomes under low (i.e., 50% and lower) versus high (i.e., 50% and higher) risks, and based on the Value-Insight Hypothesis (H2a) *lower* joint outcomes under low versus high risks; 2) based on the Uncertainty-Avoidance Hypothesis parties (H3b) would reach *higher* joint outcomes when the range of outcome risks is smaller (i.e., 20% points) versus larger (i.e., 40% points) and based on the Value-Insight Hypothesis (H3a) *lower*. Finally, we predicted that the difference in joint outcomes depending on the range of outcome risks is larger for higher versus lower risks (H4). The incentivized face-to-face negotiation Study 2 was conducted in the laboratory.

### 4.1. Method and procedure

#### 4.1.1. Participants and design

Based on an a-priori power analysis (Faul et al., 2007) for an interaction effect of  $f = 0.34$  and a power of  $1 - \beta = 0.95$ , we pre-registered a sample of 240 participants (120 dyads; see OSM for a G\*Power screenshot). To account for potential pre-registered exclusions and participants missing their assigned time slot, we invited participants until we had collected our pre-registered sample size. All scheduled participants were tested, resulting in a total sample size of 246 participants (123 dyads;  $n_{\text{female}} = 167$ ,  $n_{\text{male}} = 79$ ;  $M_{\text{age}} = 22.22$ ,  $SD_{\text{age}} = 2.53$ ; 92% students) with different academic majors (e.g., business administration, psychology). A sensitivity analysis indicated that 123 dyads would be sufficient to detect a minimum effect size of  $\eta_p^2 = 0.032$  with alpha = 0.05 and power = 0.95 for an interaction effect (and  $\eta_p^2 = 0.272$  for a one-tailed mean difference effect). Two participants indicated that their post-questionnaire data should not be used<sup>9</sup> and two failed the attention check item. These four participants were excluded from any analysis that incorporated measures from the post-questionnaire.

Participants received either course credit or €8 for their participation. To make the negotiation outcome incentive compatible, participants' possibility to earn an additional voucher that more than doubled their payment was bound to the quality of their negotiation outcome (i.e., participants were instructed that the better their negotiation outcome, the higher their chances of winning one of six vouchers). The study followed a 2 (outcome certainty [within-subjects]: certain vs. uncertain)  $\times$  2 (risk size [between-subjects]: low [ $\leq 50\%$ ] vs. high [ $\geq 50\%$ ])  $\times$  2 (risk range [between-subjects]: small [20% points] vs. large [40% points]) mixed design ( $n_{\text{LowSizeSmallRange}} = 30$  dyads,  $n_{\text{LowSizeLargeRange}} = 32$  dyads,  $n_{\text{HighSizeSmallRange}} = 29$  dyads,  $n_{\text{HighSizeLargeRange}} = 32$  dyads). Participants were randomly assigned one of two negotiator roles. The unit of analysis was the dyad.

#### 4.1.2. Procedure

We used the study procedure of Study 1 in a laboratory, face-to-face setting. We did not video-record the negotiations.

<sup>7</sup> For example, see Appendix B: Issue 1 for Party A always has the same expected value, yet the associated risks vary between the low risk small range (i.e., 20%–32%), low risk large range (i.e., 10%–34%), high risk small range (i.e., 60%–72%), and high risk large range (i.e., 50%–74%) conditions.

<sup>8</sup> The replication hypothesis of the main effect was only indirectly pre-registered.

<sup>9</sup> While this question referred to the questionnaire and not the interactive negotiation we re-ran our main analyses without these participants. None of the reported effects change significantly.

	Issue 1	Issue 2	Issue 3	Issue 4	Issue 5	Issue 6	Issue 7	Issue 8
Party A	<b>un-certain</b>	uncertain	<b>un-certain</b>	uncertain	<b>certain</b>	certain	<b>certain</b>	certain
Party B	uncertain	<b>un-certain</b>	uncertain	<b>un-certain</b>	certain	<b>certain</b>	certain	<b>certain</b>
	uncertain outcomes				certain outcomes			

Fig. 6. Study 2: structural overview of the negotiation task.

Note. In Study 2, parties faced eight negotiation issues. The priority-based trade-offs between parties needed to logroll are depicted in bold (i.e., indicating high-priority issues). In contrast to Study 1, the subsets are divided by their certainty level (i.e., certain vs. uncertain) across parties. Both subsets are fully symmetric.

4.1.3. Experimental manipulation and negotiation task

The instructions provided participants with the social-interactive decision context. In particular, participants were asked to assume the role as managers of a state in a fictitious country. The government had authorized the provision of financial aid to eight areas of sustainability development. As manager of their state, participants were tasked to negotiate with the manager of another state about the allocation of financial funding for each of the eight development areas. Five possible agreement options per development area were available, with each state achieving the highest profit when they receive as much of the funding as possible. Again, the instructions for the two parties were identical with the exception of the negotiation overview (see Appendix B) which provided parties with a payoff schedule, detailing how much profit they could expect to achieve for each agreement option.

As in Study 1, the experimental manipulation of Study 2 was implemented within parties' payoff schedules. Specifically, the payoffs included eight negotiation issues that offered integrative potential between the parties (Conflict Strength Coefficient based on Majer, Schweinsberg, et al., 2022: 0.74). Similar to Study 1, four negotiation issues provided a certain and four issues an uncertain outcome, respectively. However, contrary to Study 1, the negotiation issues were structured differently. Instead of one issue offering a certain outcome for one party and an uncertain outcome for the other, issues were realized as either offering certain or uncertain outcomes for both parties. Again, two symmetric subsets of four issues emerged (see Fig. 6). Profits were calculated using the expected value.

4.1.4. Dependent variables

4.1.4.1. Joint outcome. Similar to Study 1, the major dependent variable was dyads' joint outcome split by certainty subset. We calculated joint outcome by adding up the individual outcomes of both parties of a dyad per certainty subset. Additionally, we assessed negotiation process data by means of a first and interim proposal of both parties.

4.1.4.2. Initial yielding. As a means to explore parties' primary focus on uncertain outcomes' values versus risks, we calculated participants' initial yielding (based on Trötschel et al., 2010, 2011). In particular, we coded for each negotiation issue how many yielding steps parties made as part of their first proposals (prior to the interactive negotiation). For each negotiation issue, five agreement options were available that could be ordered from highest to lowest value. For each step away from the highest value option we added one yielding step to the initial yielding score. Scores of negotiation parties of one dyad were summed up.

Importantly, parties' outcomes within each negotiation issue were structured based on a high risk-high value approach, so that any yielding step away from a party's (objectively) highest value option provided less risk (i.e., more certainty), yet also a smaller reward. Hence, parties' first proposals allow for an exploration of their primary focus on either outcomes' values versus risks. Any yielding made for uncertain issues in the first proposal reduces parties' expected reward but increases the outcomes' certainty. With no interactive negotiation process having affected the negotiation parties yet, such first proposal yielding steps must be driven by a focus on uncertain outcomes' risks and a motivation

to reduce uncertainty. A focus on uncertain outcomes' values would forbid early yielding steps on uncertain outcome issues as these issues inherently provide the highest values.

4.1.4.3. Additional variables. For exploratory purposes we assessed a variety of variables in the post-questionnaire. Results can be found in the OSM.

4.2. Results

4.2.1. Joint outcome

A pre-registered<sup>10</sup> 2 (risk size: high vs. low) × 2 (risk range: small vs. large) × 2 (outcome certainty: certain vs. uncertain) ANOVA with repeated measures on the latter factor was conducted to test the competing Uncertainty-Avoidance (H1b) and Value-Insight (H1a) Hypotheses (i.e., higher/lower joint outcome for certain compared to uncertain outcome subset), H2 (i.e., higher/lower joint outcome for low compared to high risk size), H3 (i.e., higher/lower joint outcome for small compared to large risk range), and H4 (i.e., interaction risk size and range). The repeated measures ANOVA findings are visualized in Table 1 and Fig. 7. In line with the pre-registered Uncertainty-Avoidance H1b and replicating our findings from Study 1, parties reached higher joint outcomes ( $F(1,119) = 11.05, p = .001, \eta_p^2 = 0.085$ ) when their outcomes were certain ( $M = 176.66, SD = 9.96$ ) compared to when the outcomes were uncertain ( $M = 173.67, SD = 9.39$ ).<sup>11</sup> However, parties' ability to exploit integrative agreements did not depend on the risk size or range of their uncertain outcome issues (see Table 1). Thus, all other hypotheses have to be rejected.

4.2.2. Exploratory analyses

To conclude the result section of Study 2, we report on one further

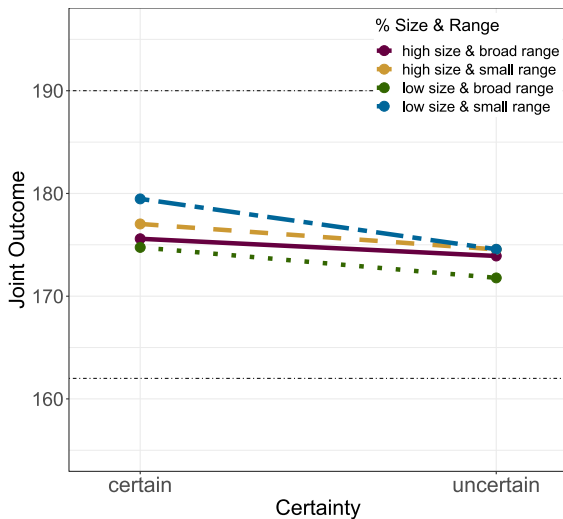
Table 1  
Study 2: pre-registered repeated measures ANOVA.

Effect	df	F	p	$\eta_p^2$
certainty	1	11.05	<b>0.001</b>	0.085
% size	1	0.01	0.931	
% range	1	2.58	0.111	
% size * % range	1	0.82	0.367	
% size * certainty	1	1.04	0.309	
% range * certainty	1	0.57	0.453	
% size * % range * certainty	1	0.10	0.754	

Note. A 2 (risk size: high vs. low) × 2 (risk range: small vs. large) × 2 (outcome certainty: certain vs. uncertain) ANOVA with repeated measures on the latter factor was run to test whether negotiation dyads' joint outcomes differ depending on the level of certainty, risk size and range condition.  $\eta_p^2$  represents the partial eta squared.

<sup>10</sup> In the pre-registration, we mistakenly described the analysis as a 'two-way mixed ANOVA', while in fact we did pre-register all three independent variables. Hence, we report the full three-way ANOVA.

<sup>11</sup> The compromise and fully integrative agreements equal profits of 162 and 190 per subset respectively.



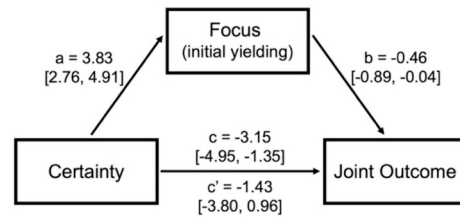
**Fig. 7.** Study 2: joint outcome by risk size and range conditions split by certainty.

Note. Fig. 7 shows the difference of parties' joint outcomes split by outcome certainty. The four line-types represent the four risk size and range conditions. The two horizontal dotted lines represent the compromise agreement (i.e., 162 per subset) and the fully integrative agreement (i.e., 190 per subset). The error bars represent standard errors. Negotiation dyads' joint outcome for the certain outcome subset was significantly higher compared to the uncertain outcome subset.

exploratory finding regarding parties' value versus risk focus. The full exploratory analyses can be found in the OSM and contain process data analyses, detailing changes in parties' trade-offs from their first proposals to the final agreement.

**4.2.2.1. Parties' focus based on initial yielding scores.** To understand whether negotiation parties focused more on the uncertain outcomes' values versus risks, we explored the initial yielding score. In particular, we tested whether parties were motivated to make more or less first proposal yielding steps for their certain versus uncertain outcome issues. Systematic higher initial yielding scores for the uncertain issues would indicate a primary focus on uncertain outcomes' risks while lower scores would indicate a primary focus on uncertain outcomes' values. Indeed we find that, in their first proposals, negotiation dyads made more yielding steps for the uncertain ( $M = 9.55, SD = 4.28$ ) compared to the certain ( $M = 5.72, SD = 5.11$ ) issues,  $t(120) = 7.14, p < .001, d = 0.65$ . Hence, for the uncertain outcome issues parties likely focused on the outcomes' risks, motivating them to make early yielding steps in order to receive less risky (lower value) outcomes as predicted by the Uncertainty-Avoidance Hypothesis.

To explore whether parties' focus on values versus risks mediates the main effect of outcome certainty on joint outcomes, we ran a Bayesian mediation analysis for within-subject designs with 10,000 iterations (Vuorre & Bolger, 2018). Specifically, we used negotiation dyads' first proposal yielding steps as a mediator of the effect of certainty on final agreements (see Fig. 8). The temporal order of our constructs conceptually justifies conducting a mediation analysis: The mediator (i.e., parties' focus on values versus risks in their pre-negotiation first proposals) was measured after the manipulation of the independent variable (i.e., provision of certain versus uncertain negotiation issues) but before the assessment of the dependent variable (i.e., final negotiation agreements). Nevertheless, we also acknowledge that additional



**Fig. 8.** Study 2: Dyads' value versus risk focus (i.e., first proposal yielding steps) accounts for the effect of certainty on joint outcome.

Note. We used a Bayesian mediation analysis for within-subject designs with 10,000 iterations (Vuorre & Bolger, 2018). The 95% credible intervals are given in square brackets. Parties' focus on uncertain outcomes' risks measured through the number of yielding steps within their first proposals accounted for the effect of certainty on joint outcome.

mediators (e.g., higher informational complexity for uncertain compared to certain issues) may account for further variance (Fiedler et al., 2018). To establish a more robust experimental causal chain, we directly manipulate parties' focus on values versus risks in Study 3 (experimental causal chain approach, see Spencer et al., 2005).

We find a direct effect of outcome certainty on joint outcome, as indicated by the credible interval (CI) not including zero ( $M = -3.15, 95\% CI [-4.95, -1.35]$ ). This effect can, however, be accounted for to a large degree by dyads' first proposal yielding steps (i.e., indirect effect includes zero:  $M = -1.43, 95\% CI [-3.80, 0.96]$ ). In sum, confronting parties with certain versus uncertain outcome issues predicts their focus on uncertain outcomes' risks (i.e., first proposal yielding steps for certain versus uncertain issues) which in turn predicts negotiation dyads' final agreement (i.e., joint outcome).

**4.3. Discussion**

Our findings from Study 1 replicated under diverse boundary conditions in Study 2. Irrespective of the size (i.e., below or above 50%) and range (i.e., 20 or 40% points) of risks that parties were confronted with, lower joint outcomes were achieved whenever outcomes were uncertain (vs. certain). In line with the Uncertainty-Avoidance Hypothesis, parties exchanged mutual trade-offs not based on priority-differences. Instead, parties resolved their conflict so that they could jointly reach more certain (lower valued) outcomes. Across our uncertainty size and range conditions, negotiators created rather similar joint outcomes. While our sample size cautions us to interpret the non-significance of the hypothesized interaction effect of risk size and range, descriptively negotiators seemed to be rather non-sensitive to risk differences. In fact, parties' trade-off behavior revealed uncertainty-avoidance in relative terms, meaning that uncertainty levels were compared to other available uncertainty levels instead of absolute levels of uncertainty (i.e., the same level of uncertainty was agreed-upon in one but not another condition).

Across two studies, varying payoff structures and diverse risk levels, parties reached lower joint outcomes for uncertain compared to certain issues. Such behavior implies that parties focus primarily on the risk component of potential negotiation outcomes, resulting in uncertainty-avoidant compromising behaviors, instead of focusing on the value component of outcomes and using the heightened visibility of priority-differences to reach integrative agreements. In a third and final study, we set out to complete the experimental causal chain design (Spencer et al., 2005) by explicitly manipulating parties' primary focus on either the value or risk component of uncertain outcomes. This approach allows us to draw inferences about how parties' focus causally impacts logrolling and hence joint outcomes. Moreover, for Study 3 we

developed a variant of our negotiation paradigm with outcome uncertainty, in which negotiators' expected value and risk levels were in line with each other (low risk - high value): parties' highest expected value option aligns with being the lowest risk option. Thereby, any compromising agreement must be driven by parties' mutual influence that they exert on each other and their joint tendency to make uncertainty-avoidant (instead of priority-based) trade-offs that reduce all parties' uncertainties for all negotiation issues.

### 5. Study 3: manipulating parties' primary focus on values versus risks

The pre-registered Study 3 aimed at testing whether explicitly manipulating the underlying mechanisms of the Value-Insight and Uncertainty-Avoidance Hypotheses, namely making negotiation parties focus on either the value or risk component of uncertain outcomes, affects their joint outcomes differently. Specifically, we manipulated parties' focus by varying the structure (Majer et al., 2020; Trötschel et al., 2015) of the uncertain outcome options allowing either the value or the risk component to vary while the respective other component remained constant (see Fig. 9).

When the uncertain outcome options provided no variation in values, parties' focus should be steered towards the risk component (i.e., *focus on risk* condition). Moreover, such an operationalization inherently aligns the highest expected value option with the lowest risk (see Appendix C<sub>3</sub>). Hence, parties should be highly motivated *not* to make any yielding steps for all negotiation issues as any yielding step not only reduces their expected value but additionally increases their risk. Should parties continue to reach lower joint outcomes under these circumstances, their behavior must be driven by a joint process of uncertainty avoidance with both parties motivating each other to make concessions on each issue so that their highest risk options can be avoided.

When the uncertain outcome options provided no variation in risks, parties' focus should be steered towards the value component (i.e., *focus on values* condition). In this condition, parties had no means to avoid uncertainty and heightened value differences should guide their priority-based trade-off behavior. Finally, we implemented a control condition with all certain outcomes. Hence, with Study 3 we are able to assess whether, in line with the Uncertainty-Avoidance Hypothesis, parties who focus on the risk component of uncertain outcomes jointly make uncertainty-avoidant instead of priority-based trade-offs, thereby collectively realizing lower-valued agreements that reduce all parties' risks:

**H5b.** When negotiators face variability in outcome risks but not in outcome values (i.e., *focus on risks* condition), they logroll *less* (i.e., reach lower joint outcomes) compared to conditions of fixed risks (i.e., *focus on values* and *control* conditions).

In addition, in line with the Value-Insight Hypothesis, parties who focus on the value component of uncertain outcomes are expected to use the heightened value differences between parties' outcomes in order to achieve higher-quality agreements:

**H5a.** When negotiators face variability in outcome values but not in outcome risks (i.e., *focus on values* condition), they logroll *more* (i.e., reach *higher* joint outcomes) compared to conditions of lower value differences (i.e., *focus on risks* and *control* conditions).

The incentivized face-to-face negotiation Study 3 was conducted in the laboratory.

#### 5.1. Method and procedure

##### 5.1.1. Participants and design

Based on an a-priori power analysis (Faul et al., 2007) for a three-groups one-way ANOVA with an effect size of  $f = 0.41$  (based on previous two studies) and a power of  $1-\beta = 0.95$ , we pre-registered a sample

of 192 participants (96 dyads; see OSM for a G\*Power screenshot). To account for potential pre-registered exclusions and participants missing their assigned time slot, we invited participants until we had collected our pre-registered sample size. All scheduled participants were tested, leading to a total sample of 196 participants. All negotiation dyads reached an agreement and none of the agreements could be considered a statistical outlier<sup>12</sup> (pre-registered cut-off three standard deviations). Hence, the final sample consisted of 98 dyads ( $n_{\text{female}} = 141$ ,  $n_{\text{male}} = 50$ ,  $n_{\text{non-binary}} = 2$ ,  $n_{\text{gender fluid}} = 2$ ,  $n_{\text{non-disclosure}} = 1$ ;  $M_{\text{age}} = 21.80$ ,  $SD_{\text{age}} = 2.89$ ; 99% students with different academic majors such as business administration or psychology). A sensitivity analysis indicated that 98 dyads would be sufficient to detect a minimum effect size of  $\eta_p^2 = 0.14$  with  $\alpha = 0.05$  and power = 0.95 for a one-way ANOVA. Three participants failed both attention check items in the post-negotiation questionnaire and were excluded from any analysis that incorporated measures from the post-questionnaire.

Participants received either course credit or €10 for their participation. To make the negotiation outcome incentive compatible, participants' possibility to earn an additional payment was bound to the quality of their negotiation outcome (i.e., participants were instructed that the better their negotiation outcome, the higher their chances of winning one of six vouchers). The study followed a  $1 \times 3$  (outcome certainty: certain versus focus on values [fixed risks & variable values] versus focus on risks [fixed values & variable risks]) between-subjects design ( $n_{\text{Certain}} = 32$  dyads,  $n_{\text{FocusOnValues}} = 33$  dyads,  $n_{\text{FocusOnRisks}} = 33$  dyads). Participants were randomly assigned one of two negotiator roles. The unit of analysis was the dyad.

##### 5.1.2. Procedure

We used the same study procedure as in Study 2.

##### 5.1.3. Experimental manipulation and negotiation task

The instructions provided participants with the same negotiation context as in Study 2. Again, the instructions for the two negotiation parties were identical with the exception of the negotiation overview (see Appendix C) which provided parties with a payoff schedule.

As with the previous two studies, the experimental manipulation of Study 3 was implemented within parties' payoff schedules. Specifically, the payoffs included eight negotiation issues that offered integrative potential between the parties (Conflict Strength Coefficient based on Majer, Schweinsberg, et al., 2022: 0.60). In contrast to Study 1 and 2, all negotiation issues in the experimental conditions provided uncertain outcomes (vs. control condition: all certain outcomes). Moreover, the uncertain agreement options varied between experimental conditions in whether they provided a fixed outcome risk but variable values per option (i.e., focus on values) or a fixed outcome value but variable risk (i.e., focus on risk; see Fig. 9). Profits were calculated using the expected value.

##### 5.1.4. Dependent variables

###### 5.1.4.1. Joint outcome. See Study 2.

**5.1.4.2. Initial yielding.** The underlying calculation of the initial yielding score follows the procedure of Study 2. However, due to the structural differences between Studies 2 and 3 (e.g., the certain control and focus on values conditions in Study 3 do not provide variability in risks), the score in Study 3 does not provide information on parties' primary focus on uncertain outcomes' values versus risks. Instead, the

<sup>12</sup> We additionally pre-registered that we would exclude negotiation dyads whose first or interim proposals were three or more standard deviations different from the mean. However, since our main focus and hypotheses concern the negotiation agreements, we decided to deviate from our pre-registration.

Condition	Certain control		Focus on values				Focus on risks			
Issue	Issue 1	Issue 2	Issue 1		Issue 2		Issue 1		Issue 2	
Party A	<b>certain</b>	certain	<b>value A</b>	% X	value D	% Y	<b>value X</b>	% A	value Y	% D
			<b>value B</b>		value E			% B		% E
			<b>value C</b>		value F			% C		% F
Party B	certain	<b>certain</b>	value F	% Y	<b>value C</b>	% X	value Y	% F	<b>value X</b>	% C
			value E		<b>value B</b>			% E		% B
			value D		<b>value A</b>			% D		% A

Fig. 9. Study 3: structural overview of the experimental conditions.

Note. In Study 3, parties faced eight negotiation issues (with five agreement options each) of which two are depicted here in reduced detail for each experimental condition. In contrast to Study 1 and 2, the outcomes of all negotiation issues were either certain (i.e., control condition) or uncertain. Uncertain outcomes per negotiation issues were either fixed in risk (i.e., focus on value) or fixed in value (i.e., focus on risk). The priority-based trade-offs between parties needed to exploit the integrative potential are depicted in bold (i.e., indicating high-priority issues). All three conditions are fully symmetric.

initial yielding score in Study 3 provides a means to explore parties' mutual yielding behavior with higher scores indicating more yielding steps.

5.1.4.3. *Manipulation check.* To measure parties' focus on either the value or risk component of their uncertain outcomes, we developed three semantic differential items (e.g., "In the negotiation, I was mainly focused on maximizing my ..." 1 = 'My Points' to 7 = 'My Probabilities [chances]'; see Appendix D). Answers on the lower end defined a primary focus on values, whereas answers on the higher end defined a primary focus on risks.

5.1.4.4. *Additional variables.* For exploratory purposes we assessed a variety of variables in the post-questionnaire. Results can be found in the OSM.

5.2. Results

5.2.1. Manipulation check

Cronbach's Alpha for the three-item manipulation check was  $\alpha = 0.85$ . Parties in the *focus on values* condition scored significantly lower ( $M = 2.76, SD = 1.09$ ) compared to parties in the *focus on risks* condition ( $M = 4.87, SD = 1.38; t(121.34) = -9.67, p < .001, 95\% CI [-2.54, -1.68], d = -1.70$ ). In line with the intended manipulation, parties primarily focused either on the value or the risk component of uncertain outcomes.<sup>13</sup>

5.2.2. Joint outcome

A pre-registered  $1 \times 3$  (outcome certainty: certain vs. focus on values vs. focus on risks) one-way ANOVA was conducted to test for differences in joint outcomes based on outcome uncertainty. Moreover, pre-registered planned contrasts were calculated. In particular, to test the Value-Insight Hypothesis, the *focus on values* condition with the highest value differences between outcome options was tested against the

<sup>13</sup> We collected additional data on parties' focus on uncertain outcomes' values versus risks which are in line with the reported successful manipulation here. See OSM under "Value vs. % Focus Scale".

combined other two conditions with lower value differences (H5a). To test the Uncertainty-Avoidance Hypothesis, the *focus on risks* condition with variable uncertainty levels was tested against the combined other two conditions with fixed uncertainty levels (H5b). The one-way ANOVA revealed a significant omnibus test ( $F(2,95) = 6.06, p = .003, \eta_p^2 = 0.113$ ). Participants in the control condition without outcome uncertainty reached the highest ( $M = 1018.06, SD = 27.12$ ), participants in the *focus on values* condition the second highest ( $M = 1003.27, SD = 30.50$ ), and participants in the *focus on risks* condition the lowest joint outcomes ( $M = 990.55, SD = 37.05$ ).<sup>14</sup> In fact, in line with the Uncertainty-Avoidance Hypothesis, parties in the *focus on risks* condition reached the lowest joint outcomes ( $F(1,95) = 12.11, p = .001, \eta_p^2 = 0.113$ ). Our planned contrast for the Value-Insight Hypothesis was not significant ( $F(1,95) = 0.01, p = .904$ ). To further analyze the difference between the two experimental conditions, a third planned comparison between the *focus on values* and *focus on risks* conditions was conducted, revealing a non-significant difference at  $t(61.73) = 1.52, p = .133$ .<sup>15</sup> Finally, joint outcomes in the *focus on values* condition were significantly lower compared to the *certain control* condition at  $t(62.54) = 2.07, p = .043, d = 0.51$ . We will further reflect on the role of uncertain outcomes for parties' exploration of priority-differences in the General Discussion. The results of Study 3 are visualized in Fig. 10.

<sup>14</sup> The compromise and fully integrative agreements equal profits of 968 and 1064 respectively.

<sup>15</sup> We exploratively re-analyzed the data while excluding dyads who reached the fully integrative agreement and therefore represent a kind of ceiling effect (three each in the control and focus on risks conditions and two in the focus on values condition). The main results change only in one aspect: dyads in the *focus on values* condition now reached significantly higher joint outcomes ( $M = 999.35, SD = 27.03$ ) compared to dyads in the *focus on risks* condition ( $M = 983.20, SD = 30.01; t(57.79) = 22.13, p = .038, d = 0.57$ ). While the uncertainty that parties in the *focus on values* condition faced continued to affect their joint outcomes negatively (compared to the certain control condition), focusing on the uncertain outcomes' values allowed them to logroll more compared to parties focusing on the risks. With this analysis being exploratory, we are cautious in interpreting these results.

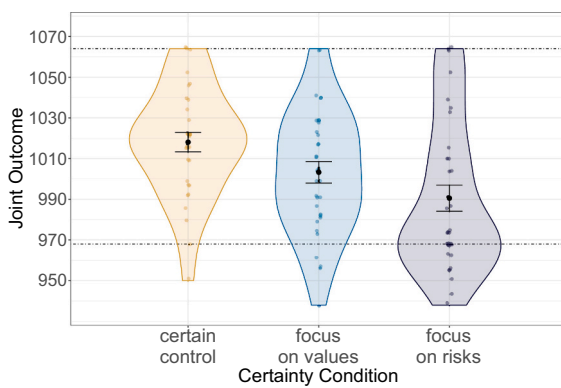


Fig. 10. Study 3: joint outcome by certainty condition.

Note. Fig. 10 shows the difference of parties' joint outcomes by certainty conditions. The two dotted lines represent the compromise agreement (at 968 points) and the fully integrative agreement (at 1064 points). The error bars represent standard errors. Significantly higher joint outcomes were reached for the certain compared to the other two conditions.

### 5.2.3. Exploratory analyses

To conclude the result section of Study 3, we explore changes in parties' yielding behavior. Complete exploratory analyses can be found in the OSM. Here we show that under specific circumstances, parties in the *focus on values* conditions were indeed able to use value-difference insights for logrolling.

**5.2.3.1. Parties' mutual trade-offs based on yielding scores.** To explore parties' mutual trade-off behavior throughout the negotiation process, we explored their yielding behavior. In particular, parties in Study 3 faced payoffs in which options with the highest expected value contained the least amount of risk. Therefore, any yielding steps parties made resulted not only in a lower value outcome, but additionally in a riskier outcome.

When considering parties' first proposals, any yielding step made must be motivated by the anticipated interaction with a counterpart and the need to reconcile conflicting interests. We find that negotiation dyads facing uncertainty made fewer initial yielding steps in their first proposals ( $M = 7.35$ ,  $SD = 4.51$ ) compared to dyads in the certain control condition ( $M = 9.11$ ,  $SD = 3.39$ ) at  $t(79.21) = 2.16$ ,  $p = .034$ ,  $d = 0.42$ . Hence, parties facing uncertainty were motivated to initially yield less as these concessions not only reduced their *expected* outcomes but additionally increased their risk levels.

However, throughout the negotiation process, parties are required to make mutual concessions that should optimally be in line with their priority-differences. In fact, we do find that the overall yielding behavior becomes similar in parties' interim proposals. The difference between the yielding scores of parties facing uncertainty ( $M = 13.55$ ,  $SD = 2.91$ ) and those facing certainty ( $M = 12.95$ ,  $SD = 2.17$ ) vanishes in the interim proposals,  $t(79.84) = -1.13$ ,  $p = .263$ . When further exploring parties' yielding scores for high- versus low-priority issues separately (in interim proposals), we find that parties facing uncertainty make more yielding steps for high-priority issues ( $M = 5.14$ ,  $SD = 2.57$ ) compared to parties facing certainty ( $M = 3.53$ ,  $SD = 1.77$ ;  $t(84.61) = -3.60$ ,  $p = .001$ ,  $d = 0.69$ ), while descriptively making fewer yielding steps for low-

priority issues ( $M = 8.41$ ,  $SD = 3.12$ ; compared to parties facing certainty:  $M = 9.42$ ,  $SD = 2.78$ ;  $t(68.76) = 1.62$ ,  $p = .110$ ). Thus, parties facing uncertainty made mutual concessions that are against their priority-differences and in line with mutual compromising.

Negotiators in the *focus on risks* condition were likely motivated to make mutual trade-offs that allowed both parties to avoid the riskiest outcome options. To do so, parties needed to jointly compromise. While parties facing uncertainty were initially more motivated to avoid yielding, the specific mutual concessions they agreed upon throughout the negotiation process compromised on their priorities, leading to lower joint outcomes. This trade-off behavior is associated with mutual uncertainty-avoidance in the *focus on risks* condition. However, parties in the *focus on values* condition had no opportunity to reduce their risks. Nevertheless, the mere presence of outcome uncertainty also reduced their logrolling and hence their joint outcomes.

### 5.3. Discussion

In line with our previous two studies, Study 3 replicated the negative effect of outcome uncertainty on parties' joint outcome in a between-subject design. Hence, the negative effect of outcome uncertainty on parties' ability to reach integrative agreements extends to circumstances in which negotiators either faced only certain or only uncertain outcomes, but no direct comparison of certain versus uncertain outcomes.

Furthermore, in Study 3 we successfully manipulated parties' focus on either the value or risk component of uncertain outcomes. In line with the Uncertainty-Avoidance Hypothesis, parties focused on uncertain outcomes' risks reached lower joint outcomes compared to parties facing fixed certainty levels (H5b). In particular, parties forced each other to compromise so that neither of them needed to take high risks, making mutual priority-based trade-offs difficult to accomplish.

Contrary to our expectation, we did not find conclusive support for the positive effect of focusing on uncertain outcomes' values (H5a). Parties focused on uncertain outcomes' values reached lower joint outcomes compared to parties facing no uncertainty. Moreover, their joint outcomes were only descriptively higher compared to parties focused on uncertain outcomes' risks. Remarkably, the mere presence of outcome uncertainty—even uncertainty that provided little to no information on the priority structure between parties (as in the *focus on values* condition)—impaired negotiators' mutual trade-off behavior. A heightened visibility of value differences did not (fully) overcome the negative effects of uncertain outcomes.

## 6. General discussion

Across three interactive experimental negotiation studies, we consistently found that social decision-makers logroll less and reach less mutually beneficial integrative agreements under contexts of outcome *uncertainty* compared to *certainty*. In fact, when confronted with uncertain outcomes, negotiation parties did not use heightened value differences between them to infer priority differences and explore integrative agreements (Value-Insight H1a; Study 1 and 2), not even when the payoff structure mainly provided information on the value component of uncertain outcomes (i.e., *focus on value* condition Study 3; H5a). On the contrary, parties' mutual exchange of trade-offs was negatively affected by a tendency to avoid agreements with higher uncertainty (Uncertainty-Avoidance H1b & H5b).

In particular, outcome uncertainty hindered parties in making priority-based trade-offs by systematically altering their mutual

concession making. In order for conflict parties to make priority-based trade-offs, each party has to stay concession-averse on high-priority issues and concede on low-priority issues (Murnighan et al., 1999; Raiffa, 1982). We found this principle to be violated in several ways in contexts of outcome uncertainty, leading to an exchange of trade-offs based on uncertainty-avoidance instead of priority-differences. In contexts of *high risk-high value*, negotiators made mutual concessions that avoided highly valued agreement options in order for both parties to achieve more certain outcomes (Study 1 and 2). In fact, parties' initial yielding on uncertain issues speaks to their focus on the risk component of uncertain outcomes, impeding their ability to make priority-based trade-offs. In contexts where *higher rewards* were associated with *lower risk* levels (Study 3), negotiators made mutual concessions that avoided highly uncertain outcomes for both parties, even on negotiation issues of lower priority, thereby omitting possibilities to make priority-based trade-offs.

Across different contexts we found that the uncertainty of outcomes hindered parties in making high-quality priority-based trade-offs. Conflict parties were more strongly influenced by the associated risk of outcomes than their (expected) profit. That is, even when the uncertainty of outcomes provided little to no information on priority-differences (i.e., *focus on values* condition Study 3), uncertainty could not be avoided and led to suboptimal joint outcomes. Importantly, although we were able to successfully manipulate negotiators' focus on the value component, the fixed uncertainty of their outcomes seemed to have impeded the joint logrolling process. This finding is in line with prior negotiation research showing that in addition to a strong egoistic motivation to increase one's own profits, logrolling requires heightened levels of pro-social motivation to increase a counterpart's outcomes too (De Dreu et al., 2007, 2000; Pruitt & Rubin, 1986). However, our participants still faced uncertainty which has been shown to make decision-makers behave less pro-socially (e.g., Exley, 2016; Kappes et al., 2018). In other words, negotiators within the *focus on values* condition of Study 3 may have focused on the value component of their risky outcomes (demonstrated by the successful manipulation check), but at the same time they did not entirely dismiss the uncertainty information which may have lowered their pro-social motivation that is needed to explore priority-based trade-offs and integrative agreements. Hence, our findings suggest that the mere presence of outcome uncertainty reduces parties' pro-social sensitivity for priority-differences and thereby limits the exploration of integrative agreements.

Moreover, negotiators' agreements in Study 2 revealed their tendency to treat uncertain outcomes in relative and not in absolute terms. Across different risk size and range conditions, parties agreed on outcomes with a specific probability in one condition, while they seemed to have deemed the same probability too risky in other conditions. Such behavior suggests that parties perceived and treated outcome uncertainty in relation to other available outcomes and their level of uncertainty. In other words, parties were less willing to agree upon the *riskiest* available option. Instead, regardless of the overall risk size or range, parties favored the second or third riskiest option.

### 6.1. Theoretical and practical contributions

By revealing that conflict parties behave differently and reach less integrative agreements when confronted with *uncertain* compared to *certain* negotiation outcomes, we highlight the importance for experimental decision researchers to incorporate real-world contextual factors into their study designs (Boothby et al., 2023). Particularly, we have developed and tested novel social-interactive experimental paradigms

that allow for the operationalization of outcome uncertainty. We thereby offer a direct means to investigate a kind of uncertainty that has received little attention in the study of integrative conflict resolution (Bottom, 1998; Essa et al., 2018; Schauer et al., 2023). Moreover, our paradigms may be used to experimentally investigate other types of uncertainty as well. For example, outcome uncertainty could stem from uncertain expectations about the counterparts' intentions to implement the agreement (Jang et al., 2018; Schauer et al., 2023).

More generally, whereas uncertainty about negotiation outcomes stemming from time delays in their implementation has been shown to positively affect agreement quality (Okhuysen et al., 2003), we show that uncertainty about the value of agreement outcomes negatively affects agreement quality (i.e., joint outcomes). Negotiators seem to be sensitive to the difference between *when* agreement outcomes materialize and *if* they materialize at all. In line with previous findings showing that gain-framed negotiators are reluctant to take risks under one specific level of uncertainty (Bottom, 1998), we find that negotiators make uncertainty-avoidant concessions irrespective of the absolute level of risk they face. Moreover, while we do find strong support for uncertainty avoidance as the main driver for reduced logrolling, with parties making uncertainty-avoidant instead of priority-based trade-offs, we have additionally shown that uncertainty reduces joint outcomes even when parties were *not* able to avoid uncertainty (i.e., *focus on values* condition Study 3). Similar to Essa et al. (2018), we find that the mere presence of outcome uncertainty negatively affects parties' sensitivity to priority-differences and therefore limits their logrolling. However, we extend Essa et al. (2018) finding, that one uncertain outcome issue alone reduces parties' joint outcomes on *different* certain outcome issues. In particular, we find that the presence of outcome uncertainty not only affects parties' joint outcome for certain issues, but to an even greater extent for uncertain issues.

From a cognitive perspective, mental accounting processes (Thaler, 1999) might offer further insights into our findings. Specifically, in an attempt to reduce the complexity of multi-issue negotiations, negotiators have been shown to process negotiation issues in separate mental accounts (Zhang et al., 2025). However, such mental accounting reduced the ability to logroll between issues of different mental accounts (Warsitzka et al., 2022). In Study 1, parties likely used different mental accounts for certain and uncertain negotiation issues, hindering their logrolling whenever trade-offs between certain and uncertain outcome issues were necessary. The same creation of mental accounts based on outcome certainty should result in less negative effects in Study 2 where integrative potential was exploitable within the certain versus uncertain outcome issues. This theorizing provides a potential explanation for the reduced main effect in Study 2.

Moreover, first proposals have repeatedly been shown to predict agreements, especially in distributive negotiations (Gunia et al., 2013; Petrowsky et al., 2023; for boundary condition see Schweinsberg et al., 2012). Likewise, we find parties' first proposals to be of particular importance in contexts of *high risk-high reward* as they mediated the effect of outcome certainty on joint outcomes. However, in our integrative negotiation paradigm of Study 2 parties' first proposals predicted joint outcomes not because of their positive effect on value claiming, but instead, because they revealed negotiators' focus on uncertain outcomes' risks. Mutual first proposal yielding set negotiators on a path towards less logrolling.

Finally, in line with the motivated information processing framework (De Dreu et al., 2008) that predicts individual level variables to affect group level outcomes, we show that parties' motivation to avoid

uncertainty transfers to the *interactive* logrolling process between negotiators. However, the joint decision-making process was negatively affected by uncertainty even in contexts in which it could not be avoided (i.e., *focus on values* condition Study 3), requiring additional joint processes to explain the detrimental effect of uncertainty on the exploration of integrative potential. Simply turning parties' focus on the uncertain outcomes' *values* does not fully overcome the negative effect that uncertainty has on negotiators' exploration of priority-differences. Overall, we see our findings as a first step to the development of evidence-based intervention that enable decision-makers in social-interactive decision-making contexts to jointly explore high-quality agreements.

## 6.2. Limitations

As with most experimental work, our findings must be interpreted with respect to their limitations. Firstly, we would like to acknowledge that the chosen operationalization of outcome uncertainty by means of probabilistic outcomes warrants consideration. While such an operationalization has great advantages when it comes to keeping certain and (different) uncertain conditions equal based on expected values, thereby allowing a more direct comparison of different levels of outcome uncertainty, decision-makers are not always able to assign specific probability values to uncertain outcomes (Thompson, 2015).

Secondly, while we were able to show that uncertainty-avoidance does account partially for the negative effect of outcome uncertainty on logrolling, we have also shown that even in contexts in which parties could not avoid uncertainty, it nevertheless negatively affected the quality of joint outcomes. However, we only have limited data to assess how parties' interaction and therefore the detrimental effect of uncertainty unfolded. First insights from related fields show that in multi-party negotiations, different levels of willingness to take risks (Boto-García & Bucciol, 2023), power dynamics (Sekścińska et al., 2022) or knowledge about the risk-taking behavior of others (Dannenberg et al., 2022) may affect negotiators' exploration of integrative agreements under outcome uncertainty.

Thirdly, uncertain decision-making contexts differ with regard to the relationship between value and risk component (see e.g., Leuker et al., 2018; Pleskac & Hertwig, 2014). Whether or not and to which degree riskier options are associated with more profitable outcomes differs across situations. In our third study, we have started to investigate contexts that do not follow a *high risk-high value* structure. However, additional experimental studies investigating whether focusing on the value versus risk component affects negotiators' ability to reach integrative agreements are necessary to fully understand when and why different foci affect negotiators' behaviors and outcomes.

Fourthly, collecting interactive behavioral data allowed us to investigate key psychological factors that shape the joint decisions that negotiators reach. However, the great amount of resources needed to collect such interactive data does limit the overall sample size that can be obtained. Thus, we acknowledge that especially our interpretation that the size and range of risks does not interactively affect negotiators' ability to reach integrative win-win agreements may warrant caution.

Finally, we would like to acknowledge that our findings are bound to conflict parties negotiating the immediate gain of benefits. Variations of the timing (Okhuysen et al., 2003), framing and valence (Majer, Zhang, et al., 2022; Trötschel et al., 2015) of outcomes as well as the conflict

type (Schuster et al., 2020) are likely to affect parties' exploration of integrative agreements.

## 6.3. Conclusion

In order to better understand how individuals' affect each other in social decision-making contexts investigating core contextual elements such as outcome uncertainty is of utmost importance (Boothby et al., 2023). Our results offer an improved understanding of negotiation parties' mutual trade-off and logrolling behaviors under outcome uncertainty. Indeed, using novel social-interactive decision-making paradigms, we have found that negotiating uncertain outcomes alters parties' sensitivity for priority-difference as well as their mutual trade-off behaviors across diverse variations of uncertainty in size, range and context. The exchange of mutually beneficial trade-offs was limited by parties' handling of uncertainty, detrimentally affecting joint outcomes.

## 6.4. Open practices

To ensure open science and transparency, we have pre-registered all three studies (Study 1: [https://osf.io/a4s7h/?view\\_only=7cf9379edbfd44e28f48a0e9644a1897](https://osf.io/a4s7h/?view_only=7cf9379edbfd44e28f48a0e9644a1897); Study 2: [https://aspredicted.org/JYV\\_SSD](https://aspredicted.org/JYV_SSD); Study 3: [https://osf.io/3yd4f/?view\\_only=2580f60aac8942ba9250b6c8526bb9cf](https://osf.io/3yd4f/?view_only=2580f60aac8942ba9250b6c8526bb9cf)) and provide public access to our Online Supplementary Materials (OSM) which include study materials, data sets, syntaxes and further supplementary materials at the OSF (Study 1: [https://osf.io/rs3c8/?view\\_only=4532fb5bebfd4f8eb6f7a937743f61d8](https://osf.io/rs3c8/?view_only=4532fb5bebfd4f8eb6f7a937743f61d8); Study 2: [https://osf.io/yz57e/?view\\_only=db206d80ce9242f5bc05bb568576c7bf](https://osf.io/yz57e/?view_only=db206d80ce9242f5bc05bb568576c7bf); Study 3: [https://osf.io/su4a8/?view\\_only=9aa72543333f4fcb9284443bc56d91bb](https://osf.io/su4a8/?view_only=9aa72543333f4fcb9284443bc56d91bb)).

## CRedit authorship contribution statement

**Marco Schauer:** Writing – original draft, Visualization, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Johann M. Majer:** Writing – review & editing, Supervision, Software, Methodology, Conceptualization. **Caroline Heydenbluth:** Writing – review & editing, Investigation, Conceptualization. **Roman Trötschel:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization.

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## Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Prof. Roman Troetschel reports financial support was provided by German Research Foundation. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A

		Party A											
		Issue 1			Issue 2			Issue 3			Issue 4		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
uncertain priority subset		58	69%	40	20	100%	20	86	58%	50	30	100%	30
		43	75%	32	16	100%	16	63	63%	40	24	100%	24
		30	80%	24	12	100%	12	44	68%	30	18	100%	18
		19	86%	16	8	100%	8	27	74%	20	12	100%	12
		9	91%	8	4	100%	4	12	81%	10	6	100%	6
certain priority subset		Issue 5			Issue 6			Issue 7			Issue 8		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
		40	100%	40	30	66%	20	50	100%	50	56	54%	30
		32	100%	32	22	72%	16	40	100%	40	41	59%	24
		24	100%	24	16	77%	12	30	100%	30	28	65%	18
	16	100%	16	10	83%	8	20	100%	20	17	70%	12	
	8	100%	8	5	88%	4	10	100%	10	8	76%	6	

		Party B											
		Issue 1			Issue 2			Issue 3			Issue 4		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
uncertain priority subset		4	100%	4	9	91%	8	6	100%	6	12	81%	10
		8	100%	8	19	86%	16	12	100%	12	27	74%	20
		12	100%	12	30	80%	24	18	100%	18	44	68%	30
		16	100%	16	43	75%	32	24	100%	24	63	63%	40
		20	100%	20	58	69%	40	30	100%	30	86	58%	50
certain priority subset		Issue 5			Issue 6			Issue 7			Issue 8		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
		5	88%	4	8	100%	8	8	76%	6	10	100%	10
		10	83%	8	16	100%	16	17	70%	12	20	100%	20
		16	77%	12	24	100%	24	28	65%	18	30	100%	30
	22	72%	16	32	100%	32	41	59%	24	40	100%	40	
	30	66%	20	40	100%	40	56	54%	30	50	100%	50	

Appendix A1. Study 1: Negotiators' negotiation overviews (simplified).

Note. Simplified negotiation overviews (for original see Appendix A2). The top (bottom) part depicts the eight-issue negotiation overview of Party A (B). Issues one to four depict the *uncertain priority subset*, while the issues five to eight depict the *certain priority subset*. The integrative agreement is highlighted using frames. Participants were only provided with their own negotiation overview, did not see the column with the calculated expected value (EV), and the order of negotiation issues was shuffled. Based on the *Value-Insight Hypothesis* negotiators should explore the integrative agreement more easily for the uncertain compared to certain priority subset as the difference between the value differences between the integrative and compromise agreement is more pronounced for the uncertain (i.e., integrative: 58 + 4 + 86 + 6 + 4 + 58 + 6 + 86 = 308 to compromise: 30 + 12 + 44 + 18 + 12 + 30 + 18 + 44 = 208) compared to the certain (i.e., integrative: 40 + 5 + 50 + 8 + 5 + 40 + 8 + 50 = 206 to compromise: 24 + 16 + 30 + 28 + 16 + 24 + 28 + 30 = 196) priority subset. Based on the *Uncertainty-Avoidance Hypothesis* negotiators should make uncertainty-avoidant trade-offs which lead to compromise agreements for the uncertain priority subset but to integrative agreements for the certain priority subset.

Party A

**Corn**

Distribution Option	Profit	%
A	58	69%
B	43	75%
C	30	80%
D	19	86%
E	9	91%

**Beans**

Distribution Option	Profit	%
A	40	100%
B	32	100%
C	24	100%
D	16	100%
E	8	100%

**Tomatoes**

Distribution Option	Profit	%
A	30	100%
B	24	100%
C	18	100%
D	12	100%
E	6	100%

**Pumpkin**

Distribution Option	Profit	%
A	56	54%
B	41	59%
C	28	65%
D	17	70%
E	8	76%

**Cauliflower**

Distribution Option	Profit	%
A	50	100%
B	40	100%
C	30	100%
D	20	100%
E	10	100%

**Lettuce**

Distribution Option	Profit	%
A	86	58%
B	63	63%
C	44	68%
D	27	74%
E	12	81%

**Asparagus**

Distribution Option	Profit	%
A	30	66%
B	22	72%
C	16	77%
D	10	83%
E	5	88%

**Potatoes**

Distribution Option	Profit	%
A	20	100%
B	16	100%
C	12	100%
D	8	100%
E	4	100%

Party B

**Corn**

Distribution Option	Profit	%
A	4	100%
B	8	100%
C	12	100%
D	16	100%
E	20	100%

**Beans**

Distribution Option	Profit	%
A	5	88%
B	10	83%
C	16	77%
D	22	72%
E	30	66%

**Tomatoes**

Distribution Option	Profit	%
A	12	81%
B	27	74%
C	44	68%
D	63	63%
E	86	58%

**Pumpkin**

Distribution Option	Profit	%
A	10	100%
B	20	100%
C	30	100%
D	40	100%
E	50	100%

**Cauliflower**

Distribution Option	Profit	%
A	8	76%
B	17	70%
C	28	65%
D	41	59%
E	56	54%

**Lettuce**

Distribution Option	Profit	%
A	6	100%
B	12	100%
C	18	100%
D	24	100%
E	30	100%

**Asparagus**

Distribution Option	Profit	%
A	8	100%
B	16	100%
C	24	100%
D	32	100%
E	40	100%

**Potatoes**

Distribution Option	Profit	%
A	9	91%
B	19	86%
C	30	80%
D	43	75%
E	58	69%

Appendix A2. Study 1: Negotiators' negotiation overviews (translated original). Note. Translated original negotiation overviews. The top (bottom) part depicts the eight-issue negotiation overview of Party A (B).

Appendix B

		Party A											
		Issue 1			Issue 2			Issue 3			Issue 4		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
uncertain subset		200	20%	40	74	27%	20	205	22%	45	107	28%	30
		139	23%	32	55	29%	16	150	24%	36	77	31%	24
		92	26%	24	39	31%	12	104	26%	27	53	34%	18
		55	29%	16	24	33%	8	64	28%	18	32	37%	12
		25	32%	8	11	35%	4	30	30%	9	15	40%	6
certain subset		Issue 5			Issue 6			Issue 7			Issue 8		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
		40	100%	40	20	100%	20	45	100%	45	30	100%	30
		32	100%	32	16	100%	16	36	100%	36	24	100%	24
		24	100%	24	12	100%	12	27	100%	27	18	100%	18
		16	100%	16	8	100%	8	18	100%	18	12	100%	12
	8	100%	8	4	100%	4	9	100%	9	6	100%	6	

		Party B											
		Issue 1			Issue 2			Issue 3			Issue 4		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
uncertain subset		11	35%	4	25	32%	8	15	40%	6	30	30%	9
		24	33%	8	55	29%	16	32	37%	12	64	28%	18
		39	31%	12	92	26%	24	53	34%	18	104	26%	27
		55	29%	16	139	23%	32	77	31%	24	150	24%	36
		74	27%	20	200	20%	40	107	28%	30	205	22%	45
certain subset		Issue 5			Issue 6			Issue 7			Issue 8		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
		4	100%	4	8	100%	8	6	100%	6	9	100%	9
		8	100%	8	16	100%	16	12	100%	12	18	100%	18
		12	100%	12	24	100%	24	18	100%	18	27	100%	27
		16	100%	16	32	100%	32	24	100%	24	36	100%	36
	20	100%	20	40	100%	40	30	100%	30	45	100%	45	

Appendix B1a. Study 2: Negotiators' negotiation overviews (low size & small range; simplified).

Note. Simplified negotiation overviews (for original see Appendix B1b). The top (bottom) part depicts the eight-issue negotiation overview of Party A (B). Issues one to four depict the *uncertain subset*, while the issues five to eight depict the *certain subset*. The integrative agreement is highlighted using frames. Participants were only provided with their own negotiation overview, did not see the column with the calculated expected value (EV), and the order of negotiation issues was shuffled. Based on the *Value-Insight Hypothesis* negotiators should explore the integrative agreement more easily for the uncertain compared to the certain subset as the difference between the value differences between integrative and compromise agreement is more pronounced for the uncertain (i.e., integrative:  $200 + 11 + 205 + 15 + 11 + 200 + 15 + 205 = 862$  to compromise:  $92 + 39 + 104 + 53 + 39 + 92 + 53 + 104 = 576$ ) compared to the certain (i.e., integrative:  $40 + 4 + 45 + 6 + 4 + 40 + 6 + 45 = 190$  to compromise:  $24 + 12 + 27 + 18 + 12 + 24 + 18 + 27 = 162$ ) subset. Based on the *Uncertainty-Avoidance Hypothesis* negotiators should make uncertainty-avoidant trade-offs which lead to compromise agreements for the uncertain subset but not the certain subset.

### Party A

Climate Education 			Expansion Hydropower 			Expansion Solar Power 			Investment Biodiversity 		
Option	Points	%	Option	Points	%	Option	Points	%	Option	Points	%
A	74	27%	A	30	100%	A	40	100%	A	205	22%
B	55	29%	B	24	100%	B	32	100%	B	150	24%
C	39	31%	C	18	100%	C	24	100%	C	104	26%
D	24	33%	D	12	100%	D	16	100%	D	64	28%
E	11	35%	E	6	100%	E	8	100%	E	30	30%

Expansion Wind Energy 			Expansion Bike Lanes 			Public Transport 			Reforestation 		
Option	Points	%	Option	Points	%	Option	Points	%	Option	Points	%
A	45	100%	A	200	20%	A	107	28%	A	20	100%
B	36	100%	B	139	23%	B	77	31%	B	16	100%
C	27	100%	C	92	26%	C	53	34%	C	12	100%
D	18	100%	D	55	29%	D	32	37%	D	8	100%
E	9	100%	E	25	32%	E	15	40%	E	4	100%

### Party B

Climate Education 			Expansion Hydropower 			Expansion Solar Power 			Investment Biodiversity 		
Option	Points	%	Option	Points	%	Option	Points	%	Option	Points	%
A	25	32%	A	9	100%	A	4	100%	A	15	40%
B	55	29%	B	18	100%	B	8	100%	B	32	37%
C	92	26%	C	27	100%	C	12	100%	C	53	34%
D	139	23%	D	36	100%	D	16	100%	D	77	31%
E	200	20%	E	45	100%	E	20	100%	E	107	28%

Expansion Wind Energy 			Expansion Bike Lanes 			Public Transport 			Reforestation 		
Option	Points	%	Option	Points	%	Option	Points	%	Option	Points	%
A	6	100%	A	11	35%	A	30	30%	A	8	100%
B	12	100%	B	24	33%	B	64	28%	B	16	100%
C	18	100%	C	39	31%	C	104	26%	C	24	100%
D	24	100%	D	55	29%	D	150	24%	D	32	100%
E	30	100%	E	74	27%	E	205	22%	E	40	100%

**Appendix B1b.** Study 2: Negotiators' negotiation overviews (low size & small range; translated original).  
 Note. Translated original negotiation overviews. The top (bottom) part depicts the eight-issue negotiation overview of Party A (B).

		Party A											
		Issue 1			Issue 2			Issue 3			Issue 4		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
uncertain subset		400	10%	40	83	24%	20	321	14%	45	115	26%	30
		200	16%	32	57	28%	16	200	18%	36	75	32%	24
		109	22%	24	38	32%	12	123	22%	27	47	38%	18
		57	28%	16	22	36%	8	69	26%	18	27	44%	12
		24	34%	8	10	34%	4	30	30%	9	12	50%	6
certain subset		Issue 5			Issue 6			Issue 7			Issue 8		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
		40	100%	40	20	100%	20	45	100%	45	30	100%	30
		32	100%	32	16	100%	16	36	100%	36	24	100%	24
		24	100%	24	12	100%	12	27	100%	27	18	100%	18
		16	100%	16	8	100%	8	18	100%	18	12	100%	12
	8	100%	8	4	100%	4	9	100%	9	6	100%	6	

		Party B											
		Issue 1			Issue 2			Issue 3			Issue 4		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
uncertain subset		10	40%	4	24	34%	8	12	50%	6	30	30%	9
		22	36%	8	57	28%	16	27	44%	12	69	26%	18
		38	32%	12	109	22%	24	47	38%	18	123	22%	27
		57	28%	16	200	16%	32	75	32%	24	200	18%	36
		83	24%	20	400	10%	40	115	26%	30	321	14%	45
certain subset		Issue 5			Issue 6			Issue 7			Issue 8		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
		4	100%	4	8	100%	8	6	100%	6	9	100%	9
		8	100%	8	16	100%	16	12	100%	12	18	100%	18
		12	100%	12	24	100%	24	18	100%	18	27	100%	27
		16	100%	16	32	100%	32	24	100%	24	36	100%	36
	20	100%	20	40	100%	40	30	100%	30	45	100%	45	

**Appendix B2a.** Study 2: Negotiators' negotiation overviews (low size & large range; simplified).  
 Note. See notes of [Appendix B1a](#).

Party A

Climate Education 			Expansion Hydropower 			Expansion Solar Power 			Investment Biodiversity 		
Option	Points	%	Option	Points	%	Option	Points	%	Option	Points	%
A	83	24%	A	30	100%	A	40	100%	A	321	14%
B	57	28%	B	24	100%	B	32	100%	B	200	18%
C	38	32%	C	18	100%	C	24	100%	C	123	22%
D	22	36%	D	12	100%	D	16	100%	D	69	26%
E	10	40%	E	6	100%	E	8	100%	E	30	30%

Expansion Wind Energy 			Expansion Bike Lanes 			Public Transport 			Reforestation 		
Option	Points	%	Option	Points	%	Option	Points	%	Option	Points	%
A	45	100%	A	400	10%	A	115	26%	A	20	100%
B	36	100%	B	200	16%	B	75	32%	B	16	100%
C	27	100%	C	109	22%	C	47	38%	C	12	100%
D	18	100%	D	57	28%	D	27	44%	D	8	100%
E	9	100%	E	24	34%	E	12	50%	E	4	100%

Party B

Climate Education 			Expansion Hydropower 			Expansion Solar Power 			Investment Biodiversity 		
Option	Points	%	Option	Points	%	Option	Points	%	Option	Points	%
A	24	34%	A	9	100%	A	4	100%	A	12	50%
B	57	28%	B	18	100%	B	8	100%	B	27	44%
C	109	22%	C	27	100%	C	12	100%	C	47	38%
D	200	16%	D	36	100%	D	16	100%	D	75	32%
E	400	10%	E	45	100%	E	20	100%	E	115	26%

Expansion Wind Energy 			Expansion Bike Lanes 			Public Transport 			Reforestation 		
Option	Points	%	Option	Points	%	Option	Points	%	Option	Points	%
A	6	100%	A	10	40%	A	30	30%	A	8	100%
B	12	100%	B	22	36%	B	69	26%	B	16	100%
C	18	100%	C	38	32%	C	123	22%	C	24	100%
D	24	100%	D	57	28%	D	200	18%	D	32	100%
E	30	100%	E	83	24%	E	321	14%	E	40	100%

Appendix B2b. Study 2: Negotiators' negotiation overviews (low size & large range; translated original).

Note. Translated original negotiation overviews. The top (bottom) part depicts the eight-issue negotiation overview of Party A (B).

		Party A											
		Issue 1			Issue 2			Issue 3			Issue 4		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
uncertain subset		67	60%	40	30	67%	20	73	62%	45	44	68%	30
		51	63%	32	23	69%	16	56	64%	36	34	71%	24
		36	66%	24	17	71%	12	41	66%	27	24	74%	18
		23	69%	16	11	73%	8	26	68%	18	16	77%	12
		11	72%	8	5	75%	4	13	70%	9	8	80%	6
certain subset		Issue 5			Issue 6			Issue 7			Issue 8		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
		40	100%	40	20	100%	20	45	100%	45	30	100%	30
		32	100%	32	16	100%	16	36	100%	36	24	100%	24
		24	100%	24	12	100%	12	27	100%	27	18	100%	18
	16	100%	16	8	100%	8	18	100%	18	12	100%	12	
	8	100%	8	4	100%	4	9	100%	9	6	100%	6	

		Party B											
		Issue 1			Issue 2			Issue 3			Issue 4		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
uncertain subset		5	75%	4	11	72%	8	8	80%	6	13	70%	9
		11	73%	8	23	69%	16	16	77%	12	26	68%	18
		17	71%	12	36	66%	24	24	74%	18	41	66%	27
		23	69%	16	51	63%	32	34	71%	24	56	64%	36
		30	67%	20	67	60%	40	44	68%	30	73	62%	45
certain subset		Issue 5			Issue 6			Issue 7			Issue 8		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
		4	100%	4	8	100%	8	6	100%	6	9	100%	9
		8	100%	8	16	100%	16	12	100%	12	18	100%	18
		12	100%	12	24	100%	24	18	100%	18	27	100%	27
	16	100%	16	32	100%	32	24	100%	24	36	100%	36	
	20	100%	20	40	100%	40	30	100%	30	45	100%	45	

**Appendix B3a.** Study 2: Negotiators' Negotiation Overviews (high size & small range; Simplified).  
 Note. See notes of [Appendix B1a](#).

### Party A

Climate Education 			Expansion Hydropower 			Expansion Solar Power 			Investment Biodiversity 		
Option	Points	%	Option	Points	%	Option	Points	%	Option	Points	%
A	30	67%	A	30	100%	A	40	100%	A	73	62%
B	23	69%	B	24	100%	B	32	100%	B	56	64%
C	17	71%	C	18	100%	C	24	100%	C	41	66%
D	11	73%	D	12	100%	D	16	100%	D	26	68%
E	5	75%	E	6	100%	E	8	100%	E	13	70%

Expansion Wind Energy 			Expansion Bike Lanes 			Public Transport 			Reforestation 		
Option	Points	%	Option	Points	%	Option	Punkte	%	Option	Points	%
A	45	100%	A	67	60%	A	44	68%	A	20	100%
B	36	100%	B	51	63%	B	34	71%	B	16	100%
C	27	100%	C	36	66%	C	24	74%	C	12	100%
D	18	100%	D	23	69%	D	16	77%	D	8	100%
E	9	100%	E	11	72%	E	8	80%	E	4	100%

### Party B

Climate Education 			Expansion Hydropower 			Expansion Solar Power 			Investment Biodiversity 		
Option	Points	%	Option	Points	%	Option	Points	%	Option	Points	%
A	11	72%	A	9	100%	A	4	100%	A	8	80%
B	23	69%	B	18	100%	B	8	100%	B	16	77%
C	36	66%	C	27	100%	C	12	100%	C	24	74%
D	51	63%	D	36	100%	D	16	100%	D	34	71%
E	67	60%	E	45	100%	E	20	100%	E	44	68%

Expansion Wind Energy 			Expansion Bike Lanes 			Public Transport 			Reforestation 		
Option	Points	%	Option	Points	%	Option	Points	%	Option	Points	%
A	6	100%	A	5	75%	A	13	70%	A	8	100%
B	12	100%	B	11	73%	B	26	68%	B	16	100%
C	18	100%	C	17	71%	C	41	66%	C	24	100%
D	24	100%	D	23	69%	D	56	64%	D	32	100%
E	30	100%	E	30	67%	E	73	62%	E	40	100%

Appendix B3b. Study 2: Negotiators' negotiation overviews (high size & small range; translated original).

Note. Translated original negotiation overviews. The top (bottom) part depicts the eight-issue negotiation overview of Party A (B).

		Party A											
		Issue 1			Issue 2			Issue 3			Issue 4		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
uncertain subset		80	50%	40	31	64%	20	83	54%	45	45	66%	30
		57	56%	32	24	68%	16	62	58%	36	33	72%	24
		39	62%	24	17	72%	12	44	62%	27	23	78%	18
		24	68%	16	11	76%	8	27	66%	18	14	84%	12
		11	74%	8	5	80%	4	13	70%	9	7	90%	6
		Issue 5			Issue 6			Issue 7			Issue 8		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
certain subset		40	100%	40	20	100%	20	45	100%	45	30	100%	30
		32	100%	32	16	100%	16	36	100%	36	24	100%	24
		24	100%	24	12	100%	12	27	100%	27	18	100%	18
		16	100%	16	8	100%	8	18	100%	18	12	100%	12
		8	100%	8	4	100%	4	9	100%	9	6	100%	6

		Party B											
		Issue 1			Issue 2			Issue 3			Issue 4		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
uncertain subset		5	80%	4	11	74%	8	7	90%	6	13	70%	9
		11	76%	8	24	68%	16	14	84%	12	27	66%	18
		17	72%	12	39	62%	24	23	78%	18	44	62%	27
		24	68%	16	57	56%	32	33	72%	24	62	58%	36
		31	64%	20	80	50%	40	45	66%	30	83	54%	45
		Issue 5			Issue 6			Issue 7			Issue 8		
		Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
certain subset		4	100%	4	8	100%	8	6	100%	6	9	100%	9
		8	100%	8	16	100%	16	12	100%	12	18	100%	18
		12	100%	12	24	100%	24	18	100%	18	27	100%	27
		16	100%	16	32	100%	32	24	100%	24	36	100%	36
		20	100%	20	40	100%	40	30	100%	30	45	100%	45

Appendix B4a. Study 2: Negotiators' negotiation overviews (high size & large range; simplified).  
 Note. See notes of Appendix B1a.

Party A

Climate Education 			Expansion Hydropower 			Expansion Solar Power 			Investment Biodiversity 		
Option	Points	%	Option	Points	%	Option	Points	%	Option	Points	%
A	31	64%	A	30	100%	A	40	100%	A	83	54%
B	24	68%	B	24	100%	B	32	100%	B	62	58%
C	17	72%	C	18	100%	C	24	100%	C	44	62%
D	11	76%	D	12	100%	D	16	100%	D	27	66%
E	5	80%	E	6	100%	E	8	100%	E	13	70%

Expansion Wind Energy 			Expansion Bike Lanes 			Public Transport 			Reforestation 		
Option	Points	%	Option	Points	%	Option	Points	%	Option	Points	%
A	45	100%	A	80	50%	A	45	66%	A	20	100%
B	36	100%	B	57	56%	B	33	72%	B	16	100%
C	27	100%	C	39	62%	C	23	78%	C	12	100%
D	18	100%	D	24	68%	D	14	84%	D	8	100%
E	9	100%	E	11	74%	E	7	90%	E	4	100%

Party B

Climate Education 			Expansion Hydropower 			Expansion Solar Power 			Investment Biodiversity 		
Option	Points	%	Option	Points	%	Option	Points	%	Option	Points	%
A	11	74%	A	9	100%	A	4	100%	A	7	90%
B	24	68%	B	18	100%	B	8	100%	B	14	84%
C	39	62%	C	27	100%	C	12	100%	C	23	78%
D	57	56%	D	36	100%	D	16	100%	D	33	72%
E	80	50%	E	45	100%	E	20	100%	E	45	66%

Expansion Wind Energy 			Expansion Bike Lanes 			Public Transport 			Reforestation 		
Option	Points	%	Option	Points	%	Option	Points	%	Option	Points	%
A	6	100%	A	5	80%	A	13	70%	A	8	100%
B	12	100%	B	11	76%	B	27	66%	B	16	100%
C	18	100%	C	17	72%	C	44	62%	C	24	100%
D	24	100%	D	24	68%	D	62	58%	D	32	100%
E	30	100%	E	31	64%	E	83	54%	E	40	100%

**Appendix B4b.** Study 2: Negotiators' negotiation overviews (high size & large range; translated original).  
 Note. Translated original negotiation overviews. The top (bottom) part depicts the eight-issue negotiation overview of Party A (B).

Appendix C

Party A											
Issue 1			Issue 2			Issue 3			Issue 4		
Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
68	100%	68	50	100%	50	93	100%	93	79	100%	79
58	100%	58	46	100%	46	82	100%	82	74	100%	74
48	100%	48	42	100%	42	71	100%	71	69	100%	69
38	100%	38	38	100%	38	60	100%	60	64	100%	64
28	100%	28	34	100%	34	49	100%	49	59	100%	59
Issue 5			Issue 6			Issue 7			Issue 8		
Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
83	100%	83	56	100%	56	105	100%	105	70	100%	70
72	100%	72	51	100%	51	95	100%	95	66	100%	66
61	100%	61	46	100%	46	85	100%	85	62	100%	62
50	100%	50	41	100%	41	75	100%	75	58	100%	58
39	100%	39	36	100%	36	65	100%	65	54	100%	54

Party B											
Issue 1			Issue 2			Issue 3			Issue 4		
Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
34	100%	34	28	100%	28	59	100%	59	49	100%	49
38	100%	38	38	100%	38	64	100%	64	60	100%	60
42	100%	42	48	100%	48	69	100%	69	71	100%	71
46	100%	46	58	100%	58	74	100%	74	82	100%	82
50	100%	50	68	100%	68	79	100%	79	93	100%	93
Issue 5			Issue 6			Issue 7			Issue 8		
Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
36	100%	36	39	100%	39	54	100%	54	65	100%	65
41	100%	41	50	100%	50	58	100%	58	75	100%	75
46	100%	46	61	100%	61	62	100%	62	85	100%	85
51	100%	51	72	100%	72	66	100%	66	95	100%	95
56	100%	56	83	100%	83	70	100%	70	105	100%	105

Appendix C1a. Study 3: Negotiators' negotiation overviews (control condition; simplified).

Note. Simplified negotiation overviews (for original see Appendix C1b). The top (bottom) part depicts the eight-issue negotiation overview of Party A (B) in the control condition. The integrative agreement is highlighted using frames. Participants were only provided with their own negotiation overview, did not see the columns with the probabilities and calculated expected value (EV). The order of negotiation issues was shuffled.

### Party A

Climate Education 		Expansion Hydropower 		Expansion Solar Power 		Investment Biodiversity 	
Option	Points	Option	Points	Option	Points	Option	Points
A	50	A	83	A	93	A	70
B	46	B	72	B	82	B	66
C	42	C	61	C	71	C	62
D	38	D	50	D	60	D	58
E	34	E	39	E	49	E	54

Expansion Wind Energy 		Expansion Bike Lanes 		Public Transport 		Reforestation 	
Option	Points	Option	Points	Option	Points	Option	Points
A	105	A	79	A	56	A	68
B	95	B	74	B	51	B	58
C	85	C	69	C	46	C	48
D	75	D	64	D	41	D	38
E	65	E	59	E	36	E	28

### Party B

Climate Education 		Expansion Hydropower 		Expansion Solar Power 		Investment Biodiversity 	
Option	Points	Option	Points	Option	Points	Option	Points
A	28	A	36	A	59	A	65
B	38	B	41	B	64	B	75
C	48	C	46	C	69	C	85
D	58	D	51	D	74	D	95
E	68	E	56	E	79	E	105

Expansion Wind Energy 		Expansion Bike Lanes 		Public Transport 		Reforestation 	
Option	Points	Option	Points	Option	Points	Option	Points
A	54	A	49	A	39	A	34
B	58	B	60	B	50	B	38
C	62	C	71	C	61	C	42
D	66	D	82	D	72	D	46
E	70	E	93	E	83	E	50

**Appendix C1b.** Study 3: Negotiators' negotiation overviews (control condition; translated original).  
 Note. Original negotiation overviews. The top (bottom) part depicts the eight-issue negotiation overview of Party A (B).

Party A											
Issue 1			Issue 2			Issue 3			Issue 4		
Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
131	52%	68	89	56%	50	148	63%	93	118	67%	79
112	52%	58	82	56%	46	130	63%	82	110	67%	74
92	52%	48	75	56%	42	112	63%	71	103	67%	69
73	52%	38	68	56%	38	95	63%	60	96	67%	64
54	52%	28	61	56%	34	78	63%	49	88	67%	59
Issue 5			Issue 6			Issue 7			Issue 8		
Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
154	54%	83	94	60%	56	159	66%	105	113	62%	70
133	54%	72	85	60%	51	144	66%	95	106	62%	66
113	54%	61	77	60%	46	129	66%	85	100	62%	62
93	54%	50	69	60%	41	114	66%	75	94	62%	58
72	54%	39	60	60%	36	98	66%	65	87	62%	54

Party B											
Issue 1			Issue 2			Issue 3			Issue 4		
Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
61	56%	34	54	52%	28	88	67%	59	78	63%	49
68	56%	38	73	52%	38	96	67%	64	95	63%	60
75	56%	42	92	52%	48	103	67%	69	112	63%	71
82	56%	46	112	52%	58	110	67%	74	130	63%	82
89	56%	50	131	52%	68	118	67%	79	148	63%	93
Issue 5			Issue 6			Issue 7			Issue 8		
Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
60	60%	36	72	54%	39	87	62%	54	98	66%	65
69	60%	41	93	54%	50	94	62%	58	114	66%	75
77	60%	46	113	54%	61	100	62%	62	129	66%	85
85	60%	51	133	54%	72	106	62%	66	144	66%	95
94	60%	56	154	54%	83	113	62%	70	159	66%	105

**Appendix C2a.** Study 3: Negotiators' negotiation overviews (focus on values condition; simplified).

Note. Simplified negotiation overviews (for original see Appendix C2b). The top (bottom) part depicts the eight-issue negotiation overview of Party A (B) in the *focus on values condition*. The integrative agreement is highlighted using frames. Participants were only provided with their own negotiation overview, did not see the column with the calculated expected value (EV) and the order of negotiation issues was shuffled.

Party A

Climate Education 				Expansion Hydropower 				Expansion Solar Power 				Investment Biodiversity 			
Option	Points	Chance	Risk 0 points	Option	Points	Chance	Risk 0 points	Option	Points	Chance	Risk 0 points	Option	Points	Chance	Risk 0 points
A	89	56%	44%	A	154	54%	46%	A	148	63%	37%	A	113	62%	38%
B	82	56%	44%	B	133	54%	46%	B	130	63%	37%	B	106	62%	38%
C	75	56%	44%	C	113	54%	46%	C	112	63%	37%	C	100	62%	38%
D	68	56%	44%	D	93	54%	46%	D	95	63%	37%	D	94	62%	38%
E	61	56%	44%	E	72	54%	46%	E	78	63%	37%	E	87	62%	38%

Expansion Wind Energy 				Expansion Bike Lanes 				Public Transport 				Reforestation 			
Option	Points	Chance	Risk 0 points	Option	Points	Chance	Risk 0 points	Option	Points	Chance	Risk 0 points	Option	Points	Chance	Risk 0 points
A	159	66%	34%	A	118	67%	33%	A	94	60%	40%	A	131	52%	48%
B	144	66%	34%	B	110	67%	33%	B	85	60%	40%	B	112	52%	48%
C	129	66%	34%	C	103	67%	33%	C	77	60%	40%	C	92	52%	48%
D	114	66%	34%	D	96	67%	33%	D	69	60%	40%	D	73	52%	48%
E	98	66%	34%	E	88	67%	33%	E	60	60%	40%	E	54	52%	48%

Party B

Climate Education 				Expansion Hydropower 				Expansion Solar Power 				Investment Biodiversity 			
Option	Points	Chance	Risk 0 points	Option	Points	Chance	Risk 0 points	Option	Points	Chance	Risk 0 points	Option	Points	Chance	Risk 0 points
A	54	52%	48%	A	60	60%	40%	A	88	67%	33%	A	98	66%	34%
B	73	52%	48%	B	69	60%	40%	B	96	67%	33%	B	114	66%	34%
C	92	52%	48%	C	77	60%	40%	C	103	67%	33%	C	129	66%	34%
D	112	52%	48%	D	85	60%	40%	D	110	67%	33%	D	144	66%	34%
E	131	52%	48%	E	94	60%	40%	E	118	67%	33%	E	159	66%	34%

Expansion Wind Energy 				Expansion Bike Lanes 				Public Transport 				Reforestation 			
Option	Points	Chance	Risk 0 points	Option	Points	Chance	Risk 0 points	Option	Points	Chance	Risk 0 points	Option	Points	Chance	Risk 0 points
A	87	62%	38%	A	78	63%	37%	A	72	54%	46%	A	61	56%	44%
B	94	62%	38%	B	95	63%	37%	B	93	54%	46%	B	68	56%	44%
C	100	62%	38%	C	112	63%	37%	C	113	54%	46%	C	75	56%	44%
D	106	62%	38%	D	130	63%	37%	D	133	54%	46%	D	82	56%	44%
E	113	62%	38%	E	148	63%	37%	E	154	54%	46%	E	89	56%	44%

Appendix C2b. Study 3: Negotiators' negotiation overviews (focus on values condition; translated original). Note. Original negotiation overviews. The top (bottom) part depicts the eight-issue negotiation overview of Party A (B).

Party A											
Issue 1			Issue 2			Issue 3			Issue 4		
Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
81	84%	68	87	58%	50	105	89%	93	113	70%	79
81	72%	58	87	53%	46	105	78%	82	113	65%	74
81	59%	48	87	48%	42	105	68%	71	113	61%	69
81	47%	38	87	44%	38	105	57%	60	113	57%	64
81	35%	28	87	39%	34	105	46%	49	113	52%	59
Issue 5			Issue 6			Issue 7			Issue 8		
Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
96	86%	83	91	62%	56	117	90%	105	110	63%	70
96	75%	72	91	56%	51	117	81%	95	110	60%	66
96	63%	61	91	51%	46	117	73%	85	110	56%	62
96	52%	50	91	45%	41	117	64%	75	110	53%	58
96	41%	39	91	40%	36	117	55%	65	110	49%	54

Party B											
Issue 1			Issue 2			Issue 3			Issue 4		
Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
87	39%	34	81	35%	28	113	52%	59	105	46%	49
87	44%	38	81	47%	38	113	57%	64	105	57%	60
87	48%	42	81	59%	48	113	61%	69	105	68%	71
87	53%	46	81	72%	58	113	65%	74	105	78%	82
87	58%	50	81	84%	68	113	70%	79	105	89%	93
Issue 5			Issue 6			Issue 7			Issue 8		
Value	%	EV	Value	%	EV	Value	%	EV	Value	%	EV
91	40%	36	96	41%	39	110	49%	54	117	55%	65
91	45%	41	96	52%	50	110	53%	58	117	64%	75
91	51%	46	96	63%	61	110	56%	62	117	73%	85
91	56%	51	96	75%	72	110	60%	66	117	81%	95
91	62%	56	96	86%	83	110	63%	70	117	90%	105

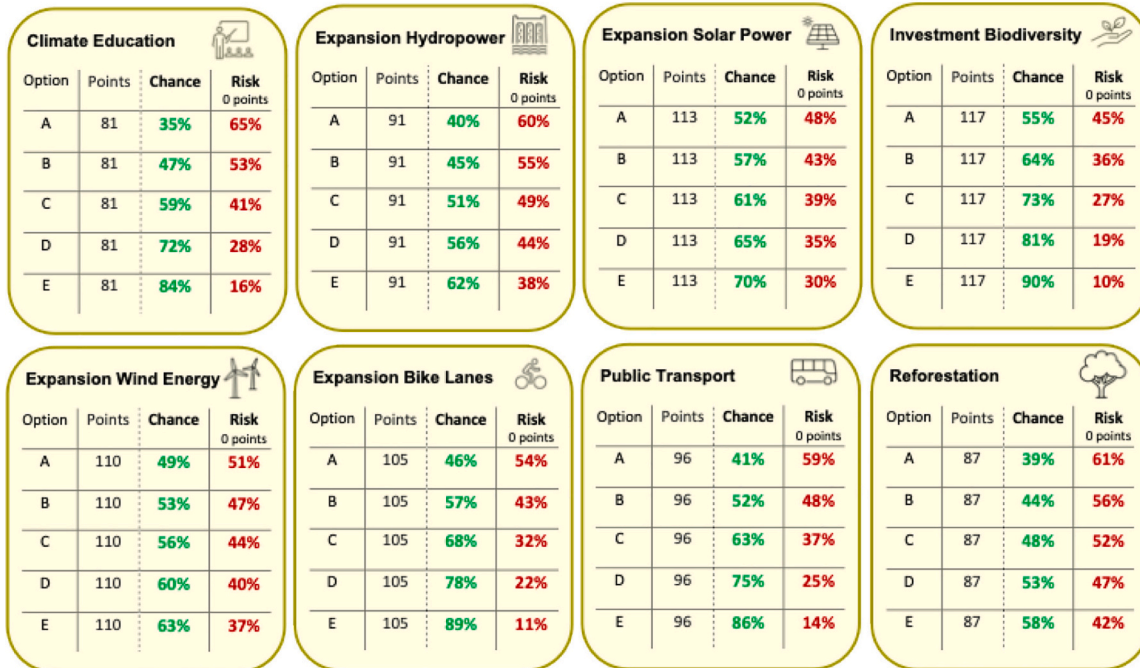
**Appendix C3a.** Study 3: Negotiators' negotiation overviews (focus on risks condition; simplified).

Note. Simplified negotiation overviews (for original see [Appendix C3b](#)). The top (bottom) part depicts the eight-issue negotiation overview of Party A (B) in the *focus on risks condition*. The integrative agreement is highlighted using frames. Participants were only provided with their own negotiation overview, did not see the column with the calculated expected value (EV) and the order of negotiation issues was shuffled.

Party A



Party B



Appendix C3b. Study 3: Negotiators' negotiation overviews (focus on risks condition; translated original). Note. Original negotiation overviews. The top (bottom) part depicts the eight-issue negotiation overview of Party A (B).

Appendix D

Study 3: Semantic differential Items as manipulation check

Item 1: In the negotiation, I was mainly focused on ...

1 = My Points - 7 = My Probabilities (chances / risks).

Item 2: In the negotiation, I was mainly focused on maximizing my ...

1 = My Points – 7 = My Probabilities (chances).

Item 3: I mainly tried to find out more about my counterparts' ...

1 = Points – 7 = Probabilities (chances / risks).

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