

“I’ll pay half the cost, for the loft” — From Searching to Agreeing on Group Property Rentals

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ABSTRACT

Rental property group booking is often a complex, asynchronous, multi-day, collaborative task that requires more than just support for search. With diverse preferences and possibly conflicting requirements, collaborative booking tools must also promote *agreement*. Informed by effective *mediation* principles, we design CREST to drive users through the stages of group booking: search, discuss and agree. Templated messages inserted by *CREST-bot*, a rule-driven agent that embodies one of many mediator roles, nudge users to consider certain properties, engage in conversations, negotiate better terms through *house rules*, and finally sign a *contract* to conclude the process. Through a mixed-methods user study, we evaluate how CREST’s novel, mediation-inspired features lead to more satisfying outcomes over a baseline that implements state-of-the-art collaborative search features.

CCS CONCEPTS

• **Human-centered computing** → **Interactive systems and tools**.

KEYWORDS

collaborative search; agreement; mediation; group decision-making

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1 INTRODUCTION

It is a family reunion. A gargantuan undertaking: Ten families plan a week-long stay at a shared eight-bedroom beach house. The grandparents can’t go up the stairs, one sister needs a bathroom for her three boys, another sister wants an entire floor to herself, and the brother in grad school can’t afford much. From family reunions to summer interns on a budget sharing rentals, collaborative bookings often lead to conflicts. Reddit’s Am I Wrong (and its more sinister

Am I the Asshole) is full of stories of poorly-made bookings, from being assigned the laundry room to being forced to move due to unaffordable rent.

As group members navigate conflicting preferences and affordability, the absence of any support for collaborative search and booking in popular real-estate search tools like AirBnB or Booking.com is jarring¹. With rising housing costs, co-housing is a growing trend [5]. Yet, there is little research on how to support this collaborative process; recent research on collaborative search tools focus on group requirements but not conflict resolution [1, 3, 25], while research on conflict resolution emphasizes algorithmic arbitration without considering user perception of fairness on such prescribed solutions [17].

Given the legal tradition of mediators — impartial sages — who empower parties to resolve their disputes and negotiate favorable outcomes, we ask (a) *what if we design a tool that acts as a mediator for group property bookings? would it help users prevent or mitigate conflicts?* and (b) *how would we design it?* We consider Moore’s eight roles of an ideal mediator when designing CREST— Collaborative Real Estate Search Tool (§3). As a *leader*, CREST guides users from searching to agreeing via a *Contracts* component. As a *facilitator and trainer*, it provides House Rules as a forum within a contract to negotiate workarounds that would make a property more appealing (e.g. less rent for a smaller room) and trains users on when and how to negotiate with friendly notifications that are posted by a rule-driven agent, CREST-bot. As a *legitimizing and opener of communication channels*, it visualizes user engagement and encourages participation through CREST-bot. As a *resource expander and problem explorer*, CREST-bot highlights suitable properties or contracts. Finally, as an *agent of reality*, it advises users on the feasibility of satisfying certain constraints.

To address the *what-if* question, we conducted a mixed-methods evaluation (§4). Our results show that users complete more satisfying group bookings with CREST compared to a *Baseline* implementing state-of-the-art collaborative search techniques. They satisfy more individual preferences, even when conflicting, through negotiation. Users report positive experiences with CREST’s components and CREST-bot, validating our design. These results suggest that mediation-inspired design can benefit other collaborative applications, such as group investment and group giving, by mediating differences in risk tolerance, contributions, and motivations.

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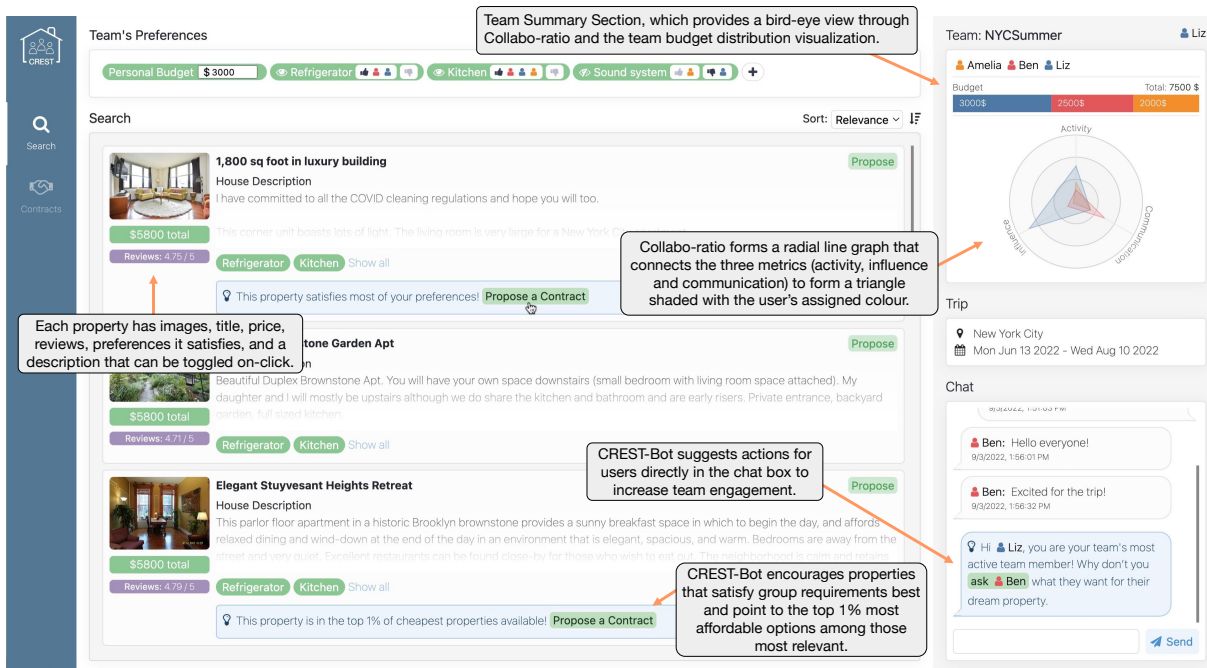


Figure 1: A screenshot of CREST showing the search page, a visualization of the team’s budget, a visualization of team engagement metrics, Collabo-ratio, and the chat panel.

2 CREST WALK-THROUGH

Amelia, Ben, and Liz, college students looking for a three-month rental in New York, start the booking process on CREST. Amelia initiates the search by entering the city and date range, then invites Ben and Liz to collaborate. On CREST’s *search page*, she refines the search by adding her budget of 2000 USD and amenity preferences to the Team’s Preferences panel. Each preference appears as a pill that Ben and Liz can thumbs-up or thumbs-down. Seeing many good properties but wanting the group’s input, Amelia messages, "Hello everyone, can’t wait to go on this adventure together," and logs off.

She logs in the following day. By then Ben and Liz have both logged in, Liz added her budget and preferences and even put forward a property for consideration, which Amelia can see in the *contracts page* (see for e.g. Figure 2). Amelia likes it, but it is slightly above her budget. She searches for other properties, noticing several notifications and messages by CREST-bot. In the search page, CREST-bot recommends a property that satisfies most of their requirements and is closer to where she will work during the summer so she proposes another contract for it. CREST-bot also encourages her to ping Ben to add his preferences with a message in the chat. The Collabo-ratio visualization shows higher engagement by herself and Liz, but not by Ben. So she accepts CREST-bot’s message and sends Ben a message to also add his preferences and make some recommendations.

Amelia logs in again later in the day, and finds that her apartment does not have the sound system that Ben needs for his work as a sound editor. She notices another contract that Liz proposed. Liz is willing to pay more for this property, if they agree to her *House Rules*. Ben has signed the contract, but is paying much less than his budget because of commuting costs and having to rent a sound system. He justifies this in the chat panel. Amelia accounts for her commute costs as well and updates her contribution to pay less than her budget, but adds a rule that she will organize taco nights to sweeten the deal and she signs the contract. Before signing the contract, Liz notices that CREST-bot points out that she is paying more than the rest and suggests adding a house rule in her favor. Liz ignores the recommendation and signs the contract, happy that they all settled on a property that they all like.

3 DESIGN

From a literature review of collaborative search or agreement tools [3, 9, 16, 20, 25], we identify three broad group-rental-booking actions:

- In *search*, users explore the space of available properties.
- In *discuss*, users communicate with each other to share their search findings, their personal living requirements, constraints and property preferences.
- In *agree*, users often work to convince each other of a few selected properties to finally settle on booking one.

We break down these three main actions into five finer-grained tasks. While these tasks may seem sequential, we find that users often engage in them in no specific order.

¹ Offerings like Common.com [18] or WeLive.com [4] provide co-living arrangements with convenient lease terms [29] but do not address the unique needs and preferences of groups [22].

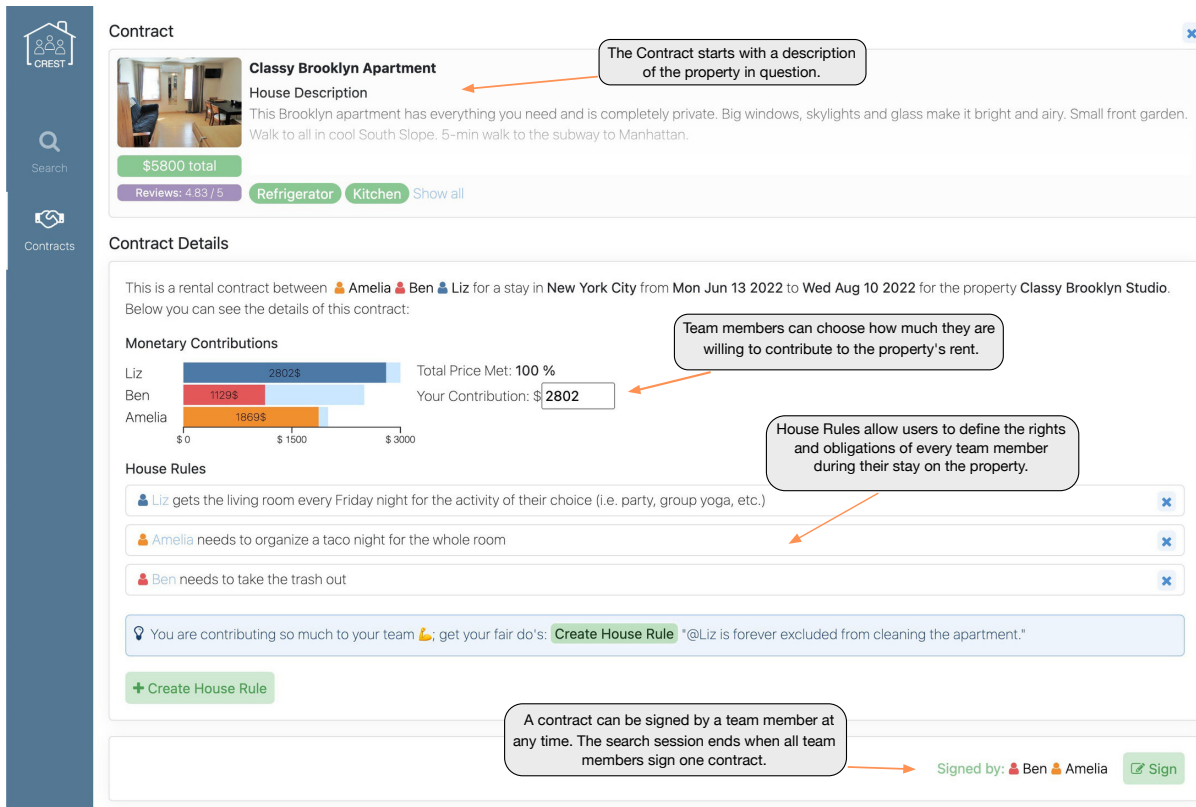


Figure 2: The contract page shows: (i) property details in the top panel, (ii) a visualization of monetary contributions vs. individual budgets, (iii) house rules, and (iv) users who have signed the contract. CREST-bot notifications nudge users to sign if agreeable, add beneficial house rules, or consider similar properties.

t1. Introspection Users self-reflect (aka. private preparation [9]) on their ideal home’s properties. Throughout the group booking process, users might reevaluate their requirements, leading to adjusted search criteria. Group discussions contribute to further introspection where users continue re-evaluate their needs.

t2. Search Users specify their search criteria through the search engine’s filters to find properties that satisfy either their (*individual search*) or a subset of the group’s criteria (*joint search*) [3, 25]. Users will often make a note of the properties they like through wishlists, bookmarks, etc. for later ranking, selection, and sharing with the group.

t3. Information Exchange Users exchange information with each other regarding their preferences, budgets, search findings and top picks, and rules for co-living. This information exchange can occur through different channels: chat messages, emails, verbal conversations, etc. [1, 25].

t4. Negotiation Users advocate for a certain property through different means. Some users trade or barter [9], others engage in fair resource allocation by agreeing on property’s space and amenities usage. Some members find *compromising* strategies where they agree to a less-desired property for the overall group’s satisfaction or in return for a negotiated perk.

t5. Ratification Users signal their agreement to proceed with booking a specific property. This might involve several rounds of confirmation or acknowledgment and can be broadcast to the group or a leader. It can take various forms, from a verbal agreement to a meticulously detailed written contract.

3.1 Challenges

c1. Conflicts & Stalemates Conflicts naturally arise in group bookings. Consider the following scenarios:

- (1) A group member who smokes and wishes to live in a space that allows smoking, and another who suffers from asthma and his condition is triggered by cigarette smoke.
- (2) Group members with different financial means.
- (3) A group member with hard-to-satisfy requirements, such as a property with a surround-sound system and sound-proofing.

All these conflicts can be creatively resolved. For example, a property with an open terrace, balcony or garden may allow the smoker to smoke without aggravating the other group member’s asthma.

Search alone cannot resolve conflicts due to conflicting preferences. Discussions help, but *cognitive inertia* and *social motivation*—resisting change or defending initial preferences [6]—can hinder compromise. The absence of an impartial voice to highlight

the difficulty of satisfying one user's requirements within the group context also impedes conflict resolution [14, 23].

Beyond discussion features, aiding users with conflict resolution is tricky. Disadvantaged users often perceive algorithms that directly arbitrate conflicts as unfair or alienating, even if they were intentionally designed for fairness. A qualitative study by Lee and Baykal [17] shows that discussion-based solutions to conflicts were perceived as fairer than "fair" social division algorithms in asset division tasks[8].

c2. Disconnected Tooling & Discontinuity Search, discussion and agreement are tightly connected in group booking: Failing to agree on a certain property may instantiate a new search where the group members are more cognizant of the factors that led to disagreement, and an awareness of the results from past independent or joint search efforts may help individuals better negotiate when trying to agree on booking a specific property. There are no tools, however, that integrate the *search, discuss and agree* functions of group property booking. Tools like SearchTogether [25] provide features for collaborative search and discussion [24] but do not consider agreement, and tools like Spliddit [8] and PocketNegotiator [9] offer some mechanisms for agreement through bidding and algorithmically deciding fair contributions, but they do not consider search and have limited discussion features.

Using multiple tools for group property search is inconvenient and can lead to discontinuity. Morris and Horvitz attribute this to a lack of awareness [25]. Discontinuity stems from the absence of a centralized system tracking members' preferences, constraints, and agreement progress. This results in duplicated efforts, prolonged searches, and increased choice fatigue.

3.2 Mediation-inspired Design

Group booking begins with search, making collaborative search a key component of CREST. We build on successful design principles from state-of-the-art collaborative search tools. CREST's Team Preferences panel on the *search page* (Figure 1) is influenced by tools like Collaborative Dynamic Queries [10], SearchTogether [11, 25], and ResultSpace [3].

Unlike collaborative search, group booking brings its own unique challenges as users have to agree on one single property to book despite different preferences or even conflicting requirements. Addressing some of the **Disconnected Tooling** challenges by designing a single tool that brings together features to support collaborative search, discussion and agreement, opens up a design opportunity: a unifying tool situates itself as a neutral, third party within a group. The tool maintains each member's requirements and preferences. And when disputes arise, it can be the voice of reason that brings the group together.

Recognizing the challenges of algorithmic arbitration, we explored mediation. Unlike arbitration, where a judge — an algorithm — settles conflicts or disputes within a group, mediation empowers group members to themselves resolve their conflicts. The mediator assists with problem-solving, negotiation and improved communication. Often, mediated outcomes are perceived as fair [17], and group relationships after mediation remain intact when compared to arbitration [26]. For mediation to work, the group members

should be ready to cooperate, aware that they might have differences, and willing to compromise [7, 23]. As this is the case with group booking, we began our design process by asking *what if we design CREST to be a mediator, how would we do so?*

We turn to *The Mediation Process*, a practical textbook on mediation by Moore for an answer [23]. Moore describes an ideal mediator as capable of assuming one of the following eight roles:

- (1) *Leader*: move the process forward through procedural, or on occasion, substantive—suggestions.
- (2) *Facilitator*: provides a procedure or forum for negotiation.
- (3) *Trainer*: educates novice, unskilled, or unprepared negotiators.
- (4) *Legitimizer*: helps group members recognize the right of others to be involved in negotiations.
- (5) *Opener of communication channels*: initiates or facilitates better communication within the group.
- (6) *Resource Expander*: offers resources to the group to enlarge the space of acceptable settlement options.
- (7) *Problem Explorer*: enables group members to examine a conflict from different viewpoints, and assists in defining preferences or interests and looks for mutually satisfactory options.
- (8) *Agent of reality*: helps build a reasonable and implementable agreement and challenges users who have extreme and unrealistic preferences.

Influenced by Moore's work, we begin by a *Baseline* collaborative search tool with many of its contemporary features including a chat panel for free-form discussion; Then, we add new features that embody the eight ideal mediator roles to support the five sub-tasks of group booking and to overcome the two main challenges of **Conflicts** and **Disconnected Tooling & Discontinuity**. Our design includes components that not only support tasks, but are supercharged by CREST-bot. CREST-bot is a rule-driven agent that inserts within CREST's components carefully-constructed, templated, mediation messages or notifications to help users reach a satisfying group selection.

A mediator helps a group move forward towards a resolution: booking a property. We achieve this through the *Contracts* component achieves this. It shows the list of properties currently under active consideration by the group members. For each property, the *Contract page* (Figure 2), allows users to focus on the single property and what it would take to cohabit the space: Users can adjust their monetary contributions, negotiate terms and conditions through *House Rules* and "sign the contract" when satisfied. Each contract shows the number of group members that have signed the contract. Users can sign multiple contracts for all the properties they are satisfied with living in. Unsigning a contract is only allowed if the terms and conditions of the contract (e.g. allocated budgets, house rules) change. When all group members sign a contract, the group booking is finalized, an email confirmation is sent to all the group members, and the process concludes.

Beyond the Contracts component itself, CREST uses language and CREST-bot messages to *lead* users through the process from the search page to the contract page. For example, within the search page (Figure 1) each property has a "propose a contract" button. Within a contract page, if a property satisfies many of the user's preferences, CREST-bot inserts a notification to encourage the user

to "sign the contract". To fulfill the *facilitator* role, we designed a forum for **Negotiation**: the *House Rules* feature within the contract page (Figure 2). House Rules function like contract clauses, defining the rights and obligations of each group member. Users can write their own rules or use a template. They allow users to *trade* (e.g., "Ben takes out the trash" in exchange for paying less), *fairly allocate resources* (e.g., "Liz gets the living room every Friday night"), and *compromise* (e.g., "Liz is excluded from cleaning the apartment" in exchange for paying the most).

House Rules are situated below a visualization of *Monetary Contributions*, which supports clear **Information Exchange** and satisfies the awareness design principle [25] by showing how much each member is willing to pay for a property and how far below or above their budget that contribution is. This placement is key to dealing with **Disconnected Tooling & Discontinuity** challenges as users do not need to context switch to a different view to get this information and it is pertinent to the **Negotiation** task.

CREST-bot super-charges this component through notifications that *train* users on how to negotiate better terms. CREST-bot uses information on a member's monetary contribution to suggest a house rule: if they are paying less than the group, it suggests to the user to offer a service, and if they are paying more, it suggests asking for a perk. CREST-bot also uses information on the degree of satisfied user preferences to prompt users to think of workarounds.

To *legitimize* the rights of all members to participate, we designed Collabo-ratio to provide visual accountability of each member's degree of participation (Top-right corner in Figure 1). Inspired by research showing that such visualizations can enhance collaboration [16], Collabo-ratio captures three engagement metrics: *activity* (user contributions to search preferences and contract proposals), *influence* (interaction with others' preferences or contracts), and *communication* (frequency of chatting with others). For each user, a radial line graph connects the three metrics, forming a triangle shaded with the user's assigned color. Ideally, equally-sized triangles indicate equal participation. CREST-bot legitimizes participation rights by inserting notifications into the chat panel, prompting active users to engage less active ones. The visualization backs the suggestion, encouraging users to involve others.

CREST-bot also adds notifications to search results to *expand* the available options and to bring their attention to ones that are likely to satisfy the group. Within a contract, it acts as the impartial voice of reason, an *agent of reality*, by illustrating the difficulty of satisfying a user's preference with notifications (e.g. "Properties that satisfy your requirement are 80% more expensive"). We balance the *leader* role, which tries to move the process forward to an agreement, with the *explorer* and *legitim�izer* roles in our design by introducing CREST-bot notifications that also steer away users from a property that does not consider the preferences of others into a similar one that does.

4 EVALUATION

Through a multi-day, asynchronous, collaborative, between-subjects user study, we set out to evaluate CREST's mediation-inspired design. Compared to the *Baseline*— a collaborative search tool inspired by state-of-the-art research [3, 10, 25] and current property-booking tools [12, 13] — participants completed more group bookings and

were more satisfied with their bookings, meeting more of their personal requirements when using CREST. They also found it easier to use CREST than the the *Baseline*. A qualitative analysis of user comments shows (i) that we do indeed surface the intended mediator role in our design of each component and (ii) overall positive ratings and comments.

Participants: We recruited 42 participants from a university-wide mailing list. We sent each participant a pre-experiment questionnaire about their demographics and search experience, and a post-experiment questionnaire with Likert-scale questions about their experience with the assigned tool. Participants were between the ages of 18 and 37, 50.0% identified as female and 50.0% as male. 85.7% have a high school diploma and 14.3% have a college degree or higher. Of those with a college degree, 57.1% had a degree in STEM, 28.6% in Social Sciences, 14.3% in Arts & Humanities. 69.0% reported having experience collaborating with people over the web.

Task: Each group of three had to find a property in New York City for a month-long stay that fits their different budgets (3000 USD, 2500 USD, and 1500 USD) and two conflicting preferences (smoking vs. no smoking, and sound system vs. no sound system). In CREST, the task was complete if all participants signed a contract. In *Baseline*, the task was complete if all participants emailed a screenshot of the agreed property to the investigators. If no agreement occurred, the experiment ended after five days. Participants could only communicate with each other via the chat interface of their assigned tool and with the researchers via email.

Role-Play: We asked participants to act as the personal-shopper of a (fictitious) client. We provided participants with a short bio and the list of requirements of their clients. Participants knew that their clients want to co-live with two others. The true identity of the participants within a group was concealed; This ensured that participants within a group only communicated via the tool. We awarded a monetary bonus (27 USD) to the participant that best represented their client's requirements in the final selected property.

We used role-play and monetary awards to (i) incentivize participants to act in their self-interest and their group's (the clients wanted to co-live) and to (ii) simulate an identical conflicting scenarios across all groups and tools.

4.1 Findings

4.1.1 How often did the groups successfully complete the booking task? Whereas all seven groups with three participants each using CREST signed a contract, six of the seven groups using *Baseline* were able to agree on a property.

4.1.2 How satisfied were users with their selection? On a 5-point Likert scale, in the post-study questionnaire, users rated their overall degree of satisfaction with the property chosen by the group.




The average rating across users using CREST was 4.52 ($\sigma = 0.68$).


The average rating across users using *Baseline* was 4.00 ($\sigma = 0.98$).


4.1.3 On average, how many user requirements were satisfied? In CREST, the average number of satisfied requirements per user was 2.7 out of a maximum of 4 possible requirements ($\sigma = 0.54$), and in

the *Baseline* it was 2 satisfied requirements per user ($\sigma = 1.01$). A requirement is satisfied if the property satisfies it (e.g. the amount paid by a user is within their budget, the property has a kitchen and the user wanted one), or if a workaround is agreed upon either through chat messages in *Baseline* or house rules in CREST.

This improvement is appreciable as there are only four requirements per user overall and at least two requirements may conflict with the requirements of other users within a team.

4.1.4 How easy was it to complete the booking task? Finally, we asked users to rate on a 5-point Likert scale how easy it was to complete a group booking exercise on CREST or *Baseline*. The mean ease-of-use ratings were 4.24 ($\sigma = 0.89$ ) for CREST and 3.92 ($\sigma = 0.78$ ) for *Baseline*. For reference, the ease-of-use rating for existing tools like AirBnB was 2.62 ($\sigma = 1.06$ )

We asked users to rate how helpful contracts were in facilitating the group booking task and users gave an average rating of 4.45 ($\sigma = 0.6$ )

Users gave an average rating of 3.80 ($\sigma = 1.47$ ) when how helpful House Rules were in facilitating the group booking task.

4.1.5 Where the eight mediator roles surfaced through CREST's features? We provide qualitative insights through sample user comments, which show how our tool embodied each of the mediator roles. We deductively grouped comments [27] following Moore's eight roles[23].

Leader

- ▶ The contracts component helped us officially “seal the deal” and it was also a sign of someone being happy with that particular property (c3:v1)

Facilitator & Trainer

- ▶ helpful as I could ask my friends to expand on their choices and explain why they went over the budget (or other things) (c2:v19)

Legitimizer & Opener of Communication Channels

- ▶ Messages about the general activity of the team were helpful in boosting the team morale, at least for me. Highlighting the number of messages sent and contracts created also helped to see the level of engagement and growing collaboration within the team. (c1:v26)

Problem Explorer & Resource Expander

- ▶ It served as a great reminder for me to be more active in the property search and group discussions. (c5:v27)

Agent of Reality

- ▶ Getting reminders about the property being outside budget/satisfies or not satisfied my requirements and to complete the task is incredibly helpful. It made me more engaged and it felt easier to narrow down the thousands of properties. (c2:v21)

Only one user negatively commented that “Automatic prompts tend to feel pushy.” (c5:v5)

5 RELATED WORKS

We review prior work in the areas of real estate search, collaborative search, and group conflict resolution.

Single-User Real Estate Search. Prior works focus on how to enable more sophisticated search criteria [15, 21]. Supporting sophisticated search criteria is complementary to our work, and with appropriate engineering, these search filters can be integrated into CREST. Commercial booking tools like Airbnb [12] and Booking.com [13] acknowledge collaborative search by allowing users to specify the number of occupants but offer little support beyond this.

Collaborative Search and Group Conflict Resolution. CREST's design is modeled after SearchTogether's design principles[25]. Many tools build on SearchTogether: ResultsSpace, for example, offers shared query history and collaborative filter controls [3]. Nakamura et al. look at the efficacy of standard collaborative search tools (with chat and bookmarking components) for group restaurant booking and affirm that these collaborative search features alone do not eliminate many of *Disconnected Tooling & Discontinuity* challenges (e.g. duplicated effort) of group booking [28]. Despite these advances, widespread adoption is lacking Morris. Avula et al. argue that dedicated collaborative search tools lack widespread adoption because users prefer non-integrated tools like search engines and messaging apps. Tools like a collaborative search bot for Slack [1] and embedding search results within a Messenger app[2] have been created to address this.

Other collaborative tools have tried to prescribe, rather than mediate, solutions to conflicts algorithmically but failed in making the users feel empowered with the algorithms decision [8, 17, 30, 31]. Murad surveys mechanisms for settling legal disputes from mediation to trial [19], noting that post-mediation relationships are often healthier [26]. This supports our design intuition that group booking tools should empower users to find compromises rather than prescribing solutions.

6 CONCLUSION

Group property bookings are a hotbed for disagreement and discord even if the group is motivated to colive, as users often have different or conflicting preferences and varying financial capacities, and they may lack the skills to negotiate or workaround these differences. We posit that a group booking tool designed as a mediator will help group members resolve conflicts and we explore how to do so by mapping eight ideal mediator roles to novel components in CREST— Contracts, House Rules, Collabo-ratio — and super-charging search, chat and contract components with CREST-bot— a rule-driven agent that adds mediation-inspired notifications within each component. A mixed-methods comparative user study of CREST against a *Baseline* that mimics state-of-the-art collaborative search tools shows that our mediation-inspired design leads to more satisfactory agreements, more satisfied requirements per user and an easier group booking experience. Future work will explore extending mediation-inspired design to other domains where group decision making is critical, including online discussions, group investments and collective charitable donations.

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