

Who Wants to Collaborate?

A Step Towards Understanding Collaboration
as Choice

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Motivation

- Flexible learning environment that supports collaborative problem solving activities



General Research Questions

- What factors influence one's choice to collaborate online?
- Could forced collaboration positively impact students' attitudes toward a subject?
- Which learning contexts are more suited for peer collaboration rather than individual assessments?
 - E.g., domain topic, type of activity, year of study, individual preference
- How should learning technology be designed to support these activities?

This Paper

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Better at Linked Lists, Yay! (BALLY)

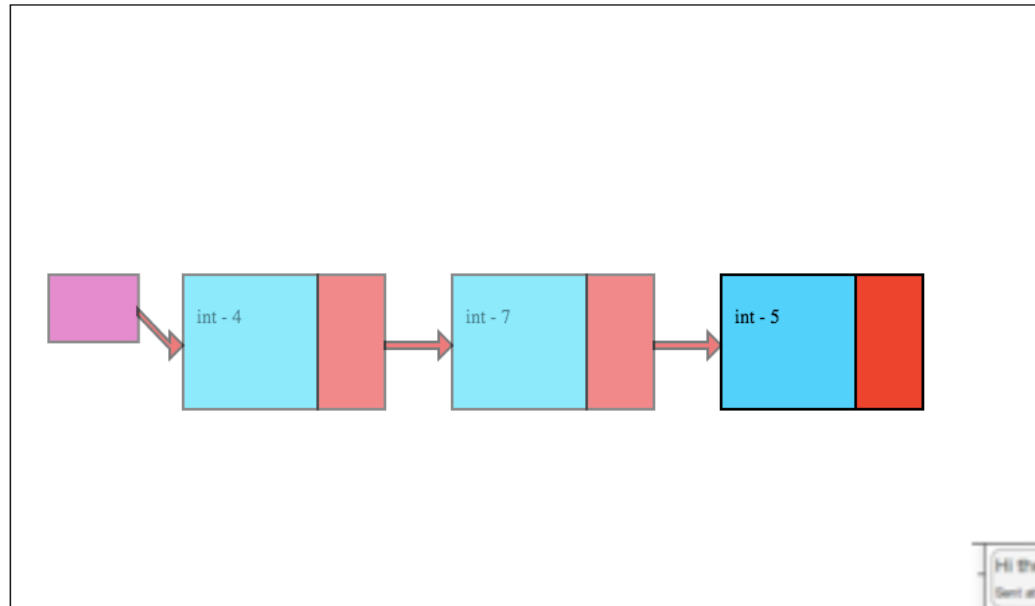
In this exercise you need to remove all nodes with odd integers as instance data.

Show Hint

Add a Temporary Variable

Add a Pointer

Restart



Submit

Hi there Sent at: 17:43	Not Atten
Oh hi Sent at: 17:43	Not Atten
We should team up Sent at: 17:44	Not Atten
Ok Sent at: 17:44	Not Atten
<input type="text"/>	
Matthew Bojey	Available Partners

Better at Linked Lists, Yay! (BALLY)

Tutorial **Current Marks** **Done as much as you want? Please take a few minutes to fill out this post-use questionnaire then enjoy your bonus marks! Note - the questionnaire must be completed to receive bonus marks.**

44 / 80 = 16.5 / 30 **PostUseQuestionnaire**

Adding Nodes	Status	Removing Nodes	Status	Reordering Nodes	Status
Question 1	Completed	Question 1	Not Attempted	Question 1	Completed
Question 2	Completed	Question 2	Completed	Question 2	Not Attempted
Question 3	Completed	Question 3	Not Attempted	Question 3	Completed
Question 4	Completed	Question 4	Not Attempted	Question 4	Not Attempted
Question 5	Completed	Question 5	Not Attempted	Question 5	Not Attempted
Question 6	Completed	Question 6	Completed	Question 6	Not Attempted
Question 7	Not Attempted	Question 7	Completed		
Question 8	Not Attempted	Question 8	Not Attempted		
Question 9	Not Attempted	Question 9	Not Attempted		

- Exercise difficulty: adding nodes < deleting nodes < reordering nodes

Study Details

- Usability Inspection
- Pilot Testing
- Evaluation in the classroom

Study Details

- Usability Inspection
 - Two second-year undergrad CS students
 - Using think-aloud protocol, independently completed tutorial, pre-test, one exercise in each category, post-test
 - Collaboratively complete any one exercise
 - Total: 45 minutes
- Pilot Testing
- Evaluation in the classroom

Study Details

- Usability Inspection
- Pilot Testing
 - Six UTAs/GTAs for CS2 course:
 - Two worked solo
 - Two pairs worked collaboratively
 - Completed tutorial, pre-test, enough exercises to get 80 points, post-test
 - Total: 40-55 minutes
- Evaluation in the classroom

Study Details

- Usability Inspection
- Pilot Testing
- Evaluation in the classroom
 - 67 students in CS2 class participated for 2% bonus
 - Conditions: worked solo (51), worked in pairs (16)
 - Solo: +4 points for each correct answer
 - Collab: +5 points for each correct answer
 - Hint: optional use, +2 points for each correct answer
 - Experiment completed when 80+ points
 - Total: 45 minutes (average)

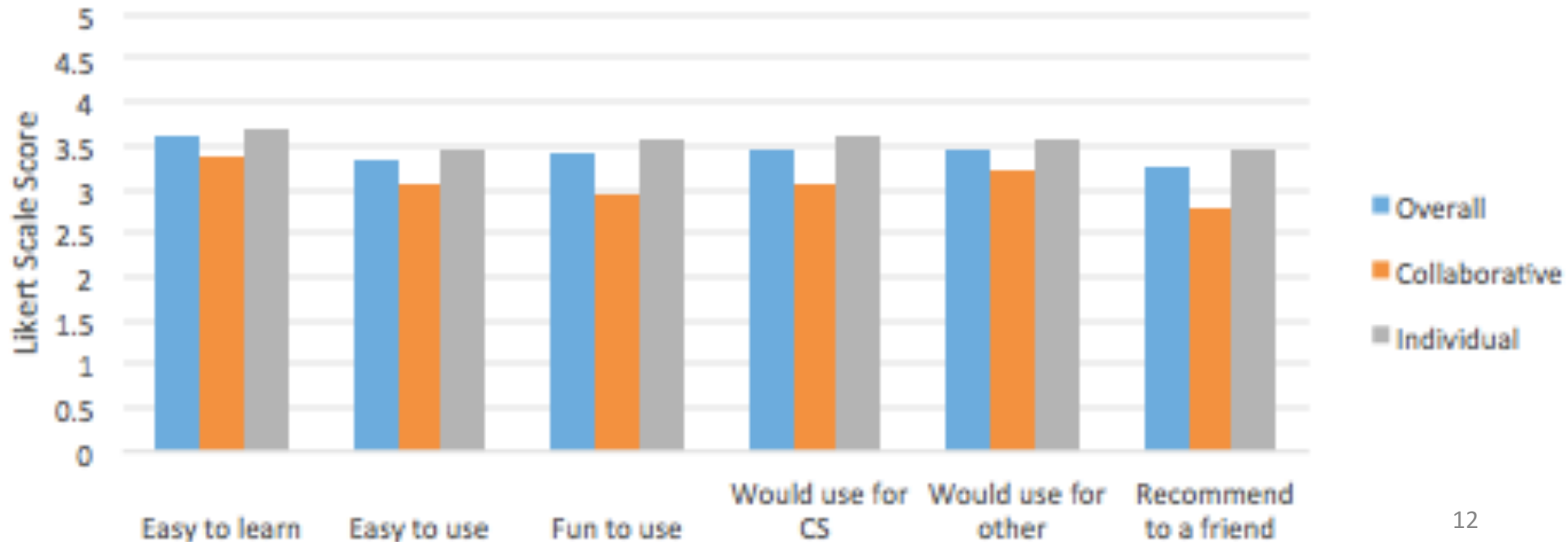
Measures

- System Usability
 - Likert scale questionnaire in post-test
 - E.g. learnability, ease of use, enjoyment, supplemental learning
- Confidence
 - Likert scale questionnaire in pre- and post-test
 - E.g. linked-list concepts and operations
- Student Performance
 - Number of attempts per exercise
 - Task completion time (per attempt)

Results: System Usability

- Significantly lower for Collab users ($p < 0.01$)
- **Design Implication:** Better collab interface and interaction

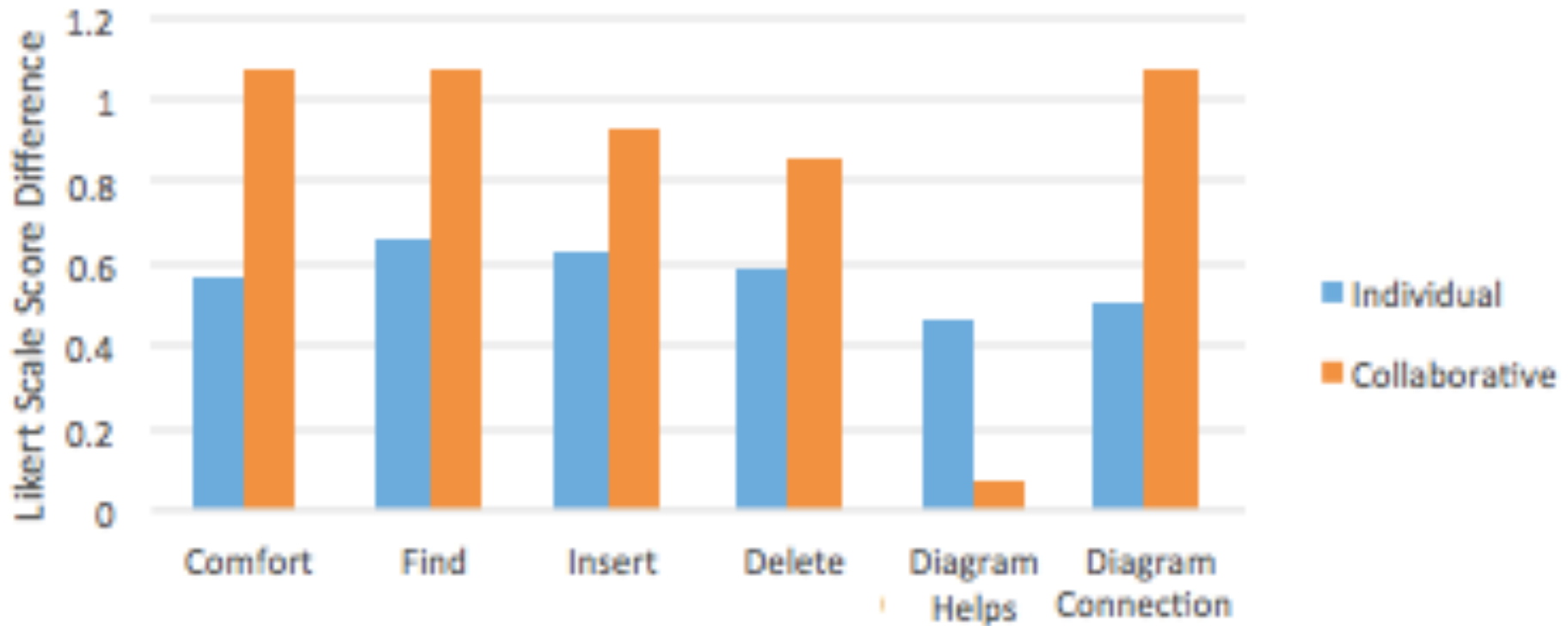
Usability Averages



Results: Confidence

- Participants who chose to work individually were significantly more confident in their own knowledge of linked lists than those who chose to work collaboratively ($p < 0.01$)
 - However, less confidence does *not* equate to worse performance
- Before vs. after BALLY: both conditions saw significant increase in confidence ($p < 0.01$)

Change in Confidence



- Collab participants became significantly more confident than Solo participants ($p < 0.01$)
- **Pedagogical Implication:** Online collaborative exercises are most beneficial for less confident students

Results: Student Performance

- Average **number of attempts** by exercise type and experimental condition

	Individual	Collaborative
Adding a Node	1.35	1.13
Deleting a Node	1.56	1.15
Reordering Nodes	1.72	1.70
Overall	1.52	1.24

- Observed difficulty matches design expectation
- Collab users took (less confident users) significantly fewer attempts to get an exercise correct than Solo users ($p < 0.05$)

Results: Student Performance

- Average **task completion time** over time
 - When correct: time decreases with experience
 - Solo: Average 35.70 seconds for an exercise
 - Collab: Average 53.51 seconds for an exercise
 - When incorrect: no trend
- Solo users are significantly faster at getting a correct answer than collab users ($p < 0.01$)
- Learning gain comparing first and last task completion times shows significant decrease in time ($p < 0.01$)

Results: Student Performance

- Number of attempts: Collab is better
- Task completion time: Solo is better
- Combined performance:
 - Number of attempts \times Task completion time
 - Solo: average 78.70 seconds
 - Collab: average 74.04 seconds
 - But no statistical significance

Conclusions

- Our BALLY system:
 - Usability:
 - Significantly lower for collab users ($p < 0.01$)
 - Learning gain:
 - Improved task completion times ($p < 0.01$)
- Findings on benefits of collaboration:
 - Confidence:
 - Supported with Likert scale questionnaire ($p < 0.01$)
 - Performance:
 - Supported in combined metrics

Future Work

- Our research questions:
 - What factors influence one's choice to collaborate online?
 - Could forced collaboration positively impact students' attitudes toward a subject?
 - Which learning contexts are more suited for peer collaboration rather than individual assessments?
 - How should learning technology be designed to support these activities?
- Explore different types of collaborative activities