Doing words together: assessing joint problem solving in a Scrabble task

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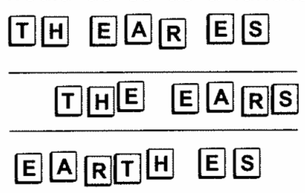
BACKGROUND AND METHODS

When are two heads better than one? Earlier studies have pointed to the crucial role of similarity in skills between participants in making communication and coordination possible (Bahrami et al 2010; Fusaroli et al 2012). Other studies have argued that participants displaying diverse cognitive strategies might have more to contribute to each other (Page 2008; Fusaroli et al 2014). In this study we employ a Scrabble-like setting (Maglio et al 1999) to explore the conditions of effective collaboration. We hypothesised that collaboration would increase word production, and that it would do so as a function of performance similarity and cognitive diversity



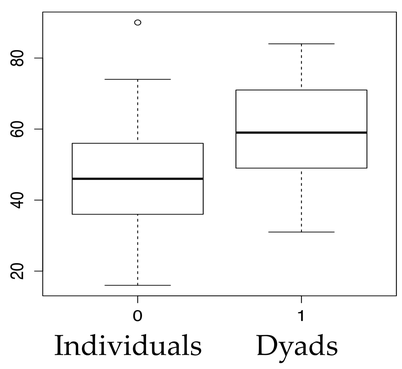
54 pairs of adult Danish participants had to generate as many words as possible from 2 balanced sets of 7 letters, either individually or collectively in a counterbalanced order. 27 pairs could manipulate the letters, 27 could not. Only correctly spelled Danish words were accepted.

Individual performance was calculated as the amount of words produced during individual trials. **Collective performance** as the amount of words produced during collective trials. **Collective benefit** in performance was calculated as the ratio between the amount of words produced during the collective trial and the individual performance of the best of the two individuals. **Performance similarity** was calculated as the ratio between the words produced by the best and the worst individual in each pair during individual trials. **Cognitive diversity** was calculated as the percentage of non-overlapping words between individuals in the individual trials. We employed mixed effects models to control for pairs and letter sets variability.

ANALYSIS

Effects of collaboration

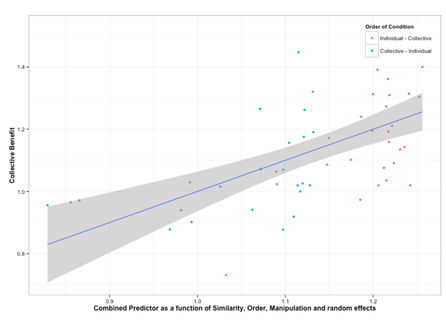
Are dyads better than individuals?



We found a **significant effect of collaboration** on performance (β=12.6, SE=1.59, t-stat= 7.94 p<0.0001), but not of manipulation (β=-2.21 , SE= 3.11, t-stat = -0.71 p= 0.48) nor order of conditions (β=1.7 , SE= 3.15, t-stat = 0.54 p= 0.59). These factors account for a marginal R2 of 0.16, p< 0.00001.

Effects of Similarity

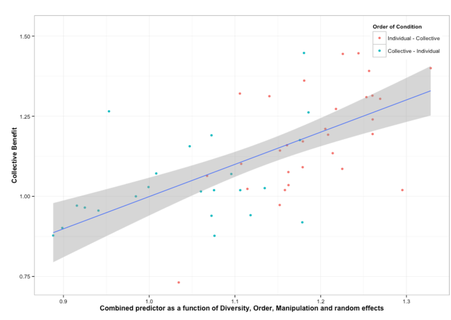
Do more similar individuals collaborate better?



We found a **significant effect of performance similarity** (β=-0.16, SE= 0.04, t-stat = -3.71 p< 0.0001) **and order of conditions** (β=-0.12, SE= 0.04, t-stat = -3.13 p< 0.001), but not of manipulation (β=-0.01, SE= 0.04, t-stat = -0.27 p= 0.78). These factors account for a marginal R2 of 0.35, p< 0.0001.

Effects of Diversity

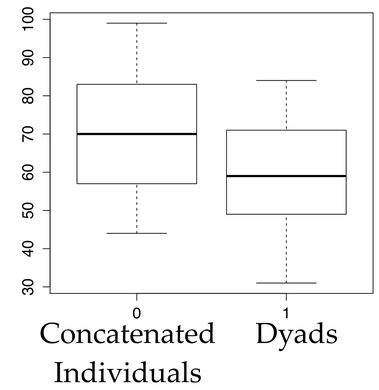
Do more cognitively diverse individual collaborate better?



We found a **significant effect of cognitive diversity** (β=1.2, SE=0.28, t-stat=4.37 p< 0.0001) and **order of conditions** (β=-0.13, SE=0.04, t-stat = -3.41 p< 0.0001), but not of manipulation (β=0.01, SE= 0.04, t-stat=0.20 p=0.84). These factors account for a marginal R2 of 0.4, p< 0.0001.

Concatenating Individuals

Is collaboration better than combining individual productions?



We found a **significant effect of concatenation vs. collaboration** (β=-9.85, SE=1.10, t-stat = -8.93 p<0.0001), but not for manipulation (β=-3.39 , SE= 3.52. t-stat=-0.96 p=0.34), nor order of conditions (β=1.71, SE=3.58, t-stat = 0.48 p= 0.63). These factors account for a marginal R2 of 0.12, p<0.0001

DISCUSSION

Collaboration is more effective than solving the task individually and it depends both on diverse cognitive strategies and similar performance levels between participants. We had expected an effect of manipulation (i.e. being able to manipulate the tiles) as participants could more effectively support each other's cognitive explorations (Maglio et al 1999; Bjørndahl et al 2014). We did not find a manipulation effect. This might be due to the limited cognitive demands of the setup (only 7 letters available). We observe that combining individual productions is more effective than actual collaboration, suggesting limits of collaboration. Finally, we observe a significant impact of order of conditions: individual performance after a collective trial is significantly higher than before one, suggesting collaboration might help individuals developing more effective strategies.

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