PERSPECTIVES

Displaced Iraqis play soccer. Christian players' prejudice decreased toward Muslim teammates but not toward Muslim strangers.

PHOTO: SPENCER PLATT/GETTY IMAGES

INTERGROUP RELATIONS

Can playing together help us live together?

A field experiment in Iraq shows that having Muslim teammates reduced Christian soccer players' prejudice

By **Elizabeth Levy Paluck** *and* **Chelsey S. Clark**

The contact hypothesis in psychology predicts that prejudice can be reduced when rival groups come together under optimal circumstances of cooperation and equal status. To date, the weight of real-world evidence for this hypothesis comes from self-reported attitudes after self-initiated contact, not from preregistered randomized trials that take intergroup contact as seriously as one would take a potential vaccine for conflict (*1*, *2*). Consequently, on page 866 of this issue, the results of Mousa's (*3*) new field experiment are breaking news. Mousa intervened in amateur Christian soccer leagues across Northern Iraqi cities affected by ISIS violence. To assess the impact of this ambitious real-world intervention, she randomly assigned Muslim players to half of the teams, measured players' behavior up to 6 months later, and posted her preregistered analysis plan and data alongside the report. Mousa finds that having Muslim teammates causes Christian players to change their behavior for the better toward Muslim players, by including them, working with them, and awarding them material signs of respect. Team-based contact with minority group members reduced prejudiced behavior toward other minority group players.

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Given its relevance for policy (Mousa notes that $877 million was allocated in 2020 toward "social cohesion" programming by the U.S. Agency for International Development) and that the contact hypothesis has been studied for many years, some may classify this research as an application of a well-known finding. This would be inaccurate. Previous research has not demonstrated cause and effect with real-world interventions or measured behaviors or otherwise leveraged the most robust research methodologies. These methods are crucial, given that the anticipated effects of contact range from positive change to backlash, in which contact stirs latent resentments. This makes Mousa's research more similar to basic science that makes progress toward fundamental evidence than to applied research that tests policy interventions based on a robust foundation of scientific evidence. Work in the field, which is often mistaken for applied research because of its location outside the laboratory, performs the function of basic science when it comes to the question of whether intergroup contact increases social cohesion.

The study presents a fundamental theoretical puzzle: Why don't the positive behavioral effects generalize out of context, or to positive intergroup attitudes? The first piece of the puzzle is that the observed changes are limited to behaviors and not attitudes. A growing number of field experiments on prejudice reduction uncover this pattern (*4*, *5*), which counters both lay and scientific notions that attitudes guide behavior. One could argue that between attitudes and behaviors, it is better to change behavior because prejudicial action is worse than harboring prejudicial attitudes. Additionally, public behaviors may cause more downstream change because they are more easily observable than private attitudes (*6*). More work is needed to measure these kinds of spillover effects, following on Mousa's finding that community members who attended more games were more likely to view religious and ethnic divisions as arbitrary. Future work can also disentangle whether attitudes are simply more difficult to change or whether current research is not measuring the correct attitudes.

Perhaps the nature of intergroup contact is useful for changing a more limited range of attitudes than those measured in the present study. Mousa observes one instance of attitude change among players: the item regarding arbitrary religious and ethnic divisions. She points out that it represents a change in "abstract attitudes rather than concrete policy positions." As it was originally conceived, the contact hypothesis was a salve for prejudice or animus, not for antagonistic political opinion or behavior (*7*). Since then, psychological evidence has grown, suggesting that prejudice-reduction interventions have inconsistent and even unintended effects on related political attitudes (*8*). Mousa defines and measures the target of her intervention, social cohesion, as a more compound concept than prejudice, involving intergroup cooperation and policy attitudes. Interventions such as contact that are intended to soften attitudes toward outgroups may need to be combined with additional activities to channel newfound goodwill into a political or policy position. Early work on interracial contact in the United States recognized this point. For example, in addition to creating ideal contact conditions for Black and White individuals working in teams, one study using Black actors to mention instances of discrimination and race-based hardship helped White participants connect their experience to larger societal issues (*9*).

The second piece of the theoretical puzzle is that changes in behavior toward other Muslim players in the league did not generalize to changes in behavior toward Muslim strangers. Mousa offers possible explanations, including ongoing threat from recent anti-Christian violence, the fragile quality of the contact with other players, and the possibility that behavior change takes longer to manifest. Another

possibility rests in the basic math of the league's intergroup contact: Christian leaders allowed a maximum of three Muslim players on treatment teams. This limitation represents a hard-won insight about the difficulty of implementing intergroup contact interventions in post-conflict settings but may have limited the generalizability of behavioral effects.

Psychological theory predicts that individuals can make positive generalizations from one prototypical group member to the rest of the group (*10*). The handful of Muslim players may have been seen as exceptional, not prototypical, in the eyes of the Christian players, similar to other contexts with a token number of outgroup individuals. If the Muslim players were considered an exception to the rule, psychological theory would not predict that positive impressions of Muslim players would generalize to their group.

Another consequence of the small number of Muslim players is that it inhibits the research from exploring effects on both sides of the intergroup contact. Mousa's data suggest that Muslim players' prejudice did not change over time, but there are too few Muslims and no Muslim control group to rigorously test this claim. Leaving out the perspectives of minority group members, who are often instrumentalized for the purpose of attitude change among the majority, is a pattern in intergroup contact research. There is much to learn by studying reactions to intergroup contact among minority group participants.

This landmark study cuts a clear path for future scholarship. Generalized answers will only emerge after more experimental work that may seem like policy application but is actually basic science, working systematically toward robust conclusions. Mousa is one of a cohort (*2*) of young scientists who are leading the way. ■

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MARINE ECOLOGY

Marine food webs destabilized

A combination of warming and acidification threaten marine biomass and productivity

By **Steven L. Chown**

Forecasting the ecological consequences of climate change requires both observations and experiments. Among the most informative experiments are manipulations of ecosystems, either through large outdoor interventions or through the construction of mesocosms (*1*)—replicas of the natural world that enable conditions to be carefully controlled. Mesocosms typically mimic the complexity of natural ecosystems, enabling researchers to disentangle how these systems work now and what path they might follow as future conditions change. They can also be replicated, enabling signal to be distinguished from the variability that is an inherent feature of natural systems. On page 829 of this issue, Nagelkerken *et al.* (*2*) report on their use of mesocosms to better understand the future of marine systems and the ecological services they deliver. They find that marine benthic ecosystems have limited capacity to respond to a future combination of warming and acidification, with considerable degradation a potential outcome.

Nagelkerken *et al.* address several key questions. Their experiments explore the way that ecological interactions will play out under end-of-century temperature and ocean acidification conditions compared with those now. They assess how species with similar functions, but different responses to changing physical conditions, replace each other, thus preserving the form of ecological interactions (especially feeding) among community members. They also aim to determine whether the trophic structure of present-day marine systems (see the figure, left)—with a high biomass of primary producers and lower biomasses of primary and secondary consumers—will be maintained as physical conditions change.

Nagelkerken *et al.* constructed replicas of Australian marine benthic systems, including all of the major groups of organisms that might be expected: cyanobacteria, algae, copepods, shrimps, crabs, molluscs, polychaetes, brittle stars, sponges, and fish. Primary producers (such as algae) and both primary (molluscs) and secondary (fish, crabs) consumers were represented by the species included in the mesocosms, as were typical feeding interactions among species and trophic levels. The 1800-liter mesocosms were then either exposed to conditions typical of those along the South Australian coast (a control setting) or exposed to increased temperature, simulated acidification, or a combination of the two, as expected at the end of this century under the Intergovernmental Panel on Climate Change's Representative Concentration Pathway 8.5 (RCP8.5) scenario. RCP8.5 is based on an extreme anthropogenic greenhouse gas emissions scenario, but one that continues to be plausible (*3*). Nagelkerken *et al.* then investigated food web structure in the form of feeding interactions and the way in which biomass and productivity change among trophic groups.

Simulated ocean acidification had little effect, except for a benefit from bottom-up resource enrichment. By contrast, although food web structure was relatively insensitive to temperature and to the combination of temperature and acidification, both biomass and productivity were greatly reorganized among trophic groups (see the figure, center). In effect, and especially under combined warming and acidification, primary producer and secondary consumer biomass and productivity increased, whereas substantial declines occurred among primary consumers. As Nagelkerken *et al.* point out, such trophic imbalance is unlikely to be stable in the long term. Rather, it represents a transitory state, with one likely outcome the collapse of the system such that primary producers dominate and secondary consumers, such as fish, are largely lost (see the figure, right). Less extreme outcomes might result if species are capable of adapting to the combination of warmer temperatures and higher acidity.

The outcomes from these mesocosm experiments are worrying. Secondary marine consumers, such as fish and larger invertebrates, are an important nutritional source for people (*4*). Indeed, demersal and small pelagic fish now dominate global fisheries catch (*5*). Yet these important marine resources are under pressure because of fishing for human consumption (*6*) or the production of fish meal for aquaculture (*7*). These mesocosm trials suggest that this direct

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