HIGHER EDUCATION

A brief intervention to improve college success and equity

A large-scale experiment focused on social belonging shows impacts on first-year full-time completion

By **Nicholas A. Bowman**

Around the world, substantial proportions of students who begin postsecondary education do not complete their degree (*1*, *2*). Overall graduation rates often mask considerable differences by race, gender, age, and institutional type (*1*, *2*). In an effort to promote student success and equity, social psychologists have created interventions that seek to reframe challenges that students may face in their college environments to help them overcome obstacles and persist in school. On page 499 of this issue, Walton *et al.* (*3*) describe an ambitious randomized controlled experiment that tested a social-belonging intervention among >26,000 incoming students at 22 US colleges and universities. This brief intervention increased the proportion of students who completed their first year as full-time students, which is a key leading indicator of future college graduation (*4*).

This social-belonging intervention sought to reduce students' concerns about whether they will belong in college by conveying two messages: First, many students are concerned about belonging and may experience substantial doubts and challenges early on, such as difficulty making friends or receiving poor grades. Second, students generally overcome these challenges and ultimately feel a sense of belonging. The intervention delivered these messages by sharing with participants a combination of survey results and personal stories from older students. Study participants were then asked to reflect on these themes and write about why belonging concerns are likely to diminish over time during college, perhaps drawing upon their own personal experiences with transitions. A focus on belonging constitutes one potential mechanism for improving success and equity, and this type of belonging intervention has been used in prior research. Other psychological interventions have focused on students' perceptions that they can improve their achievement and intelligence through hard work and appropriate strategies or that their coursework will help them achieve their own valued goals (*5*, *6*).

Walton *et al.* expand on prior research in three important ways. First, whereas previous social-psychological interventions have often been implemented in classrooms or one-on-one settings, this intervention was conducted online and sent to entire cohorts of incoming college students (usually as one of several administrative tasks that students completed before their initial college enrollment). Despite potential limitations (e.g., difficulty in fully maintaining students' attention to the intervention), this online administration provides a straightforward way to reach thousands of students before they start college.

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Next, whereas previous research has often occurred with students at selective universities, this study examined a rather broad range of institutions, which is notable when a meta-analysis of various psychological interventions and academic outcomes found considerably larger effect sizes at selective institutions (*6*). Walton *et al.* conducted a formal analysis of the generalizability of their findings, which suggested that these can be extrapolated to a population of 749 colleges and universities that enroll more than one million incoming full-time, degree-seeking students each year.

And lastly, from a theoretical perspective, this study provides direct insights into when and for whom these social-belonging interventions are most likely to work. Researchers have frequently demonstrated that students who face negative stereotypes based on their identities (e.g., Black and Latinx students, students from lower socioeconomic backgrounds, women in math and science coursework) exhibit notably larger benefits from psychological interventions than do other students (*6*–*8*). This is consistent with prevailing theory that highlights how these groups of students receive implicit and explicit messages casting doubt on their potential to belong in college and succeed academically (*9*).

However, a broad focus on students' identities may only tell part of the story. Walton *et al.* argue for the importance of "local-identity groups" for determining who may benefit most from the intervention; these groups consist of a particular combination of race, first-generation status, college, and cohort. Walton *et al.* suggest that two criteria must be met for the intervention to be successful with each of these local-identity groups: (i) students face vulnerability to worries about belonging in college, and (ii) students have meaningful opportunities to belong in college. This second criterion has often been overlooked in previous research; a psychological intervention may try to persuade students that they will eventually belong, but students may not believe or internalize that message if they consistently encounter a hostile campus environment. Walton *et al.* demonstrated that the intervention was most successful when both of these criteria were met, which therefore led to greater equity in full-time completion.

Among local-identity groups who fit the two criteria, the intervention yielded roughly a 2 percentage-point increase in the likelihood of completing the first year as a full-time student. This effect could be perceived as trivial, but it may be practically important. Based on the generalizability analyses, this intervention would lead to approximately 12,000 additional students completing full-time enrollment every year if it were administered at those 749 colleges and universities. Social-psychological interventions frequently have substantial effect sizes if the outcomes are closely related to the theoretical mechanism of interest (*5*, *7*), but effect sizes are much smaller when the outcomes measure academic achievement and are even smaller for college retention or persistence (*6*–*8*). Given the myriad factors that may influence whether a student leaves or stays in college, 2 percentage points for a short precollege intervention seems notable.

Future research is necessary to further explore the conditions in which psychological interventions may be effective. In terms of institutional type, a national study showed that a sense of belonging in college was only related to mental health and college persistence at 4-year institutions (*10*), which suggests that a social-belonging intervention may not work at 2-year institutions. Moreover, although substantial

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racial disparities in college graduation occur at predominantly white institutions, Black students graduate at the same rate as white students from 4-year institutions where at least half of undergraduates identify as Black, and there is also no graduation gap between Latinx and white students at majority-Latinx 4-year institutions (*11*). As a result, the social-belonging intervention may not be effective for these well-represented local-identity groups by race and college.

Additional research may also help explore features of interventions that are most effective. Walton *et al.* used a well-established and theoretically grounded approach in which the stories of previous students highlighted the presence of belonging challenges among those holding different racial and gender identities. Some previous evidence suggests that stories linking specific challenges and adjustment strategies to students' identities or backgrounds (e.g., first-generation status) can provide an especially effective approach for promoting college success among students who hold minoritized identities (*12*). However, this strategy also has the potential to backfire if it gives the impression that students from a particular identity group are unlikely to ultimately belong or succeed in college. Fortunately, colleges and universities can implement this established intervention as part of their efforts to bolster student retention and graduation, because the online materials in the Walton *et al.* study are freely available (*13*). ■

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COOLING TECHOLOGY

Sustainable cooling with water generation

Dual-use devices offer a different path for more-sustainable living

By **Primož Poredoš** *and* **Ruzhu Wang**

A fivefold increase in cooling-related greenhouse gas emissions is expected by 2050 (*1*) from a combination of improved standards of living, especially in countries with humid climates, and the ongoing overall warming of the planet. Alternative approaches to efficient cooling are required to meet these needs. Although a large effort is underway to improve the energy efficiency of cooling more generally, a potentially important strategy is found by looking at the small water droplets that emerge on cold surfaces. Most people have experience with this process, from the condensation formed from air conditioners to cold drinks taken from a refrigerator. Although conventional chillers are becoming more efficient, integrating a passive radiative cooling strategy in which the sky is used as a cold sink could not only improve performance but also produce fresh water. This may help with cooling and potentially also with water scarcity issues in many regions of the world.

The water vapor dewing process has a large barrier owing to its inefficiency. An established figure of merit known as a coefficient of performance (COP) represents the ratio of useful cooling energy generated to the work provided [$COP = Q_{cool}(T_E)/W(T_E,T_C)$]. In general, the COP of chillers depends on the temperature difference between the hot (T_C) and cold (T_E) sides. Air conditioning requires air dehumidification, but water vapor dewing introduces a larger temperature difference and thus decreases the COP. This likely requires a reconceptualization of humidity management.

Synergistic and multifunctional effects can be realized by focusing on the air-water-energy nexus, primarily driven by water separation from the air. Pulling the water vapor from the air achieves air dehumidification while also creating a source of fresh water. Several studies already have demonstrated more than a twofold energy efficiency increase by decoupling latent from sensible cooling, predominantly in humid climate conditions (*2*). Splitting the water vapor–capturing process from sensible cooling sparked a pertinent question concerning the viability of dual-use devices that promote efficient cooling and freshwater generation (*3*). Although the dual nature of devices is relatively straightforward in terms of economic and performance efficiency for hot and humid regions, severe challenges exist for deploying these systems in hot and dry places.

Arid regions typically have abundant natural sunlight under clear sky conditions, offering a sustainable way to either increase or decrease the internal energy of a material relative to the ambient. The elevated temperature of a wet material accelerates a drying process, with water vapor released to the ambient. By contrast, the reversibility of that process is facilitated by hygroscopic porous materials that capture water from the atmosphere owing to the water concentration difference, according to Fick's law. In 2017, a proof of concept showed water harvesting from the air in outdoor arid conditions by using a porous metal-organic framework (*4*). In just a few years, atmospheric water harvesting has come a long way, from diurnal devices to ones using multiple cycles per day (*5*), even in the desert environment (*6*), swiftly converging to continuously operated devices not only by sorbent–desiccant but also using daytime radiative sky cooling materials (*7*). Attaining the dual-use feature of existing water harvesters with cooling capabilities could potentially be accomplished by reengineering existing devices rather than reinventing materials.

Sustainable cooling in arid regions requires a two-step approach (see the figure) owing to intrinsic material and heat-transfer characteristics. Sorbent at subambient temperature lowers outdoor air temperature while simultaneously promoting water capture, culminating in cooled and dehumidified air. As the adsorption process generates heat, both sensible and adsorption heat (Q_{ADS}) can be taken away by using radiative cooling ($Q_{C,RC}$) (*8*) or a desiccant-based heat pump ($Q_{C,HP}$) (*2*). The addition of the latter device with its capability of adsorbing moisture from the handled

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