Drawing on cognition and affect to trigger interest and learning:  
The *ICAN Intervention*

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Objectives and Theoretical Framework

How to engage learners as productive participants in science inquiry is a critical question for educators (see Engle & Conant, 2002; Lehrer & Schauble, 2006). However, inadequate knowledge of science content and methods has been described as limiting the potential of inquiry-based learning for a new learner of science (Chin, Brown, & Bruce, 2002; Metz, 1994).

This study was undertaken in order to explore the potential of the ICAN Intervention to impact the motivation and learning of at-risk inner city youth in an inquiry-based out-of-school science workshop. Informed by social-psychological interventions (e.g. Cohen, Garcia Apfel, & Master, 2006; Hulleman & Harackiewicz, 2009; see Yeager & Walton, 2011) and informed by research on writing (e.g. Boscolo & Mason, 2001; Langer & Applebee 1987), as well as data from research on science learning (see Lehrer & Schauble, 2006), the intervention consists of writing responses to ICAN probes as part daily lab work. The probes are written by instructors to encourage reflection and extension of the content being addressed in workshop sessions. Thus, an example of an ICAN probe from work on cell energy and the cell cycle was: “ICAN explain how cells get energy through cellular respiration and fermentation…” The participants’ responses to the ICAN probes were used as records of present thinking and were ungraded.

Methods and Data Sources

Participants were 10-12 year-old youth participating in a choral training program to which out-of-school science was added for 5 weeks during the summer; they had little to no formal training in science. Two cohorts of children were studied for purposes of replication. The workshops for each had parallel, inquiry-informed content and structure, and were facilitated by the same instructor. The first cohort included 9 (2 b, 7 g) participants; the second included 13 (5 b, 8 g) participants.

Two types of control groups were employed. In the first, data from 8 (3 b, 5 g) participants who had previously participated in a parallel workshop also with the same content, structure, and instructor, but who did not receive the intervention; the second control group consisted of same age youth (17; 4 b, 13 g) from the same community who were not enrolled in a workshop.

Data sources included: participant observation throughout the workshop; pre- and post workshop interviews with participants that were used to identify participant interest (e.g. Hidi & Renninger, 2006), self-efficacy (Eccles, Wigfield, Harold, & Blumenfeld, 1993), and Identity-based Motivation (Oyserman, 2010). The interview also included work with 3 established science tasks adapted for this population to assess science-as-
theory (e.g., Carey et al., 1989), science as practice (e.g., Rosebury, Warren, & Conant, 1992), and science as formal logic (e.g., Chen & Klahr, 1999); and artifacts from the workshops including lab notebooks and responses to ICAN probes.

Results and Significance

In brief, analysis of the motivation and learning of target and control participants indicates that those who received the intervention outperformed both of the control groups; and those in the Inquiry-only Control Group made gains that those who had no workshop did not. Only those receiving the ICAN Intervention had meaningful long-term improvements in addressing what science is, what types of questions scientists ask, how they ask them, and how they go about testing those questions, however. Moreover, in the controlling variables assessment, only these participants showed improvement in identifying the variables being compared.

Participants identified as having high and low interest showed the same gains on each of these tasks, and their gains held 5 weeks following workshop completion.

Participants with high interest and low interest were also no more likely to complete the ICAN probes on a regular basis. However, those who did complete more ICAN probes were also those who made significant improvements in understanding what science is and how an experiment works. In other words, the learning gains that are made can be attributed to consistent work with the ICAN probes.

Furthermore, participants in the ICAN Intervention and the Inquiry-only Control Group showed gains in their interest that was sustained 5-weeks following the workshop. No gains were found for either self-efficacy or Identity-based Motivation.

It appears that the triggering of interest for learners new to formal science is piqued by the presence of inquiry and develops enough to be sustained following the workshop context. It also is in this context that the ICAN Intervention promotes learning specific to processes associated with science as theory, and to some extent with science as logical reasoning. And, importantly, the intervention requires written reflection about the science content of the days’ activities, presumably allowing them to consolidate their understanding of the science on which they are working.

However, no changes in the youths’ feelings of self-efficacy or Identity-Based Motivation were evident, nor were there changes in their work with the types of tasks, the science as practice, and the transfer component of the controlling variables task, that would have involved the youth to act as scientists.

The youth are participants in a children’s choir and as such more readily imagine themselves pursuing music. To say that they are scientists would be a big jump in identity.

Interestingly, they are all fully engaged in the workshop activity at all times. No one indicates during the interviews that he or she lacks feelings of self-efficacy, or thinks that he or she cannot do science. In fact, they describe the science workshop as something they like because it is an opportunity to learn and when they have science in school they distinguish between it and science in the workshop—describing the science in the workshop as “real science”.

Asked specifically in the Time 3 interview about whether they felt that the workshop instructors thought that they were doing a good job in science, they all say yes—and asked how they know, they cite specific examples of the instructors giving them this
feedback at one time or another. It appears that what the workshop is supporting them to approach the science tasks on which they are being assessed as problems to be solved. They may not yet see the problems as science problems, or approach the problem solving as a scientist.

Based on interest theory it is likely that if it continues to be supported, their developing interest in science may eventually support them to feel more self-efficacious and to identify with science as well as music, and to engage the processes of problem solving as scientists eventually. At present, we can only conclude that are positioned to continue want to learn science.

References


