

Building upon the CALLA Framework: The Intersection of Novel Problem Solving and Applied Wisdom

Commentary on Wu, Rebok, and Lin

Thomas Chan · Michelle C. Carlson

Johns Hopkins University, Baltimore, MD, USA

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The major issue with cognitive training interventions for older adults is that they typically fail to result in enduring skills that elicit far transfer – cognitive abilities that generalize to other independent functions [for exception, see Rebok et al., 2014]. In their novel Cognitive Agility across the Lifespan via Learning and Attention (CALLA) framework, Wu, Rebok, and Lin [2016] tackle this issue by exploring the optimal bioecological factors in early life that are most conducive to broad learning and the development of skills that generalize. Next, they frame the six critical factors that promote broad learning (basic cognitive abilities and far transfer of skills) and examine how they change over the life course. These factors offer implications for interventions designed at fostering neuroplasticity in the aging brain.

Our commentary offers some additional important contributions of the CALLA framework to existing models and poses challenges and opportunities in the design of cognitive interventions that facilitate skills that far transfer for older adults. Specifically, this framework makes additional contributions as we extend it here to the bioecological systems framework and to engagement interventions. From here, we also identify the following challenges of implementing the factors of CALLA into cognitive interventions for older adults, including motivational shifts away from learning goals (socioemotional selectivity theory) and disposition towards certainty compared to novelty. Lastly, we identify the opportunities to create conditions that leverage older adults to apply their experience, knowledge, and skills towards novel problem solving.

Contributions of the CALLA Framework

One major contribution of the CALLA framework, although not explicitly referenced by Wu et al., is that it can be incorporated into a *bioecological systems framework* [Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 2006]. The CALLA framework seeks to understand the continuously changing processes of broad learning development as the interplay between person characteristics (learner; input- or knowledge-driven learning, growth or fixed mindset, and focus on single or multiple development of skills), and contextual factors (degree of individualized scaffolding and forgiving or unforgiving learning environments). Application of this perspective is well timed as the field of human development shifts towards understanding development within environmental contexts [e.g., Jaeger, 2016]. This is evident as more and more researchers are using complex statistical methods (e.g., growth mixture modeling, latent moderating-causal modeling) to investigate how processes change as the person and their context change (i.e., the transactions between process, person, and context).

Furthermore, as demonstrated by a very recent issue of *Human Development* (vol. 59, issue 4), greater refinement towards a testable science of the bioecological systems framework is gaining traction and will undoubtedly be at the forefront of understanding developmental interventions in context – for whom do these interventions work and under what conditions do they work? The CALLA framework contributes to this conversation by moving back towards a developmental science of aging to consider the ever-changing interactions between the developing individual and her/his environment.

The CALLA framework also provides a theoretical direction for cognitive interventions to focus on novel learning and skill development to promote far transfer. Specifically, to fostering CALLA's first critical factor of broad learning, open-minded input-driven learning is "most easily elicited in completely novel situations; i.e., where there is the greatest mismatch between environmental demand and prior knowledge" [Wu et al., 2016, p. 345]. Research suggests that novelty – proximity variety of activities – is a significant predictor of cognitive health and a lessening of the likelihood of developing cognitive impairments in older adults [Carlson et al., 2012].

The introduction of novelty has been highlighted in intervention design, especially those that explicitly investigate the differences between training and engagement intervention models [see Stine-Morrow et al., 2014]. Briefly, cognitive training improves specific skills through explicit instruction and practice in controlled contexts, while cognitive engagement often targets a variety of abilities through exposure to complex environments that may require flexible updating in real time [e.g., Carlson, 2011; Carlson et al., 2012; Stine-Morrow et al., 2014]. The engagement model conforms to the CALLA framework by shifting older adults from knowledge-based learning towards more input-driven learning and inducing learning of multiple skills simultaneously. These critical factors are important according to CALLA because as people age, they become much more reliant on past experiences, assumptions, and routines to process information in the environment – hence the introduction of novelty in engagement interventions is critical to promoting far transfer. Overall, the CALLA framework suggests to us that researchers take the more complex and potentially messier approach of incorporating cognitive engagement interventions in the real world to foster the development of skills that promote far transfer.

The CALLA framework argues for two critical contextual factors to consider when designing engaging cognitive interventions aimed at developing far transfer abilities: (a) providing *individualized scaffolding* (i.e., *feedback*) to support those skills to be developed and (b) offering a *forgiving supportive environment* to cultivate motivation to continue development of the targeted skills. Wu et al. effectively demonstrate how these two factors are prevalent in earlier life learning, but diminish via ecological (e.g., lack of tolerance) or intrapsychic (e.g., stereotype threat) barriers in aging adults. The CALLA framework provides potential avenues for how cognitive interventions can encourage and support this type of learning in aging adults. For example, these interventions could include interactive computer guides, mentors, and other mediums to provide tailored feedback to hone the development and use of multiple skills.

Challenges of Applying CALLA Factors to Intervention Design

Here, we identify motivational challenges towards engagement in novel problem solving. Putting older adults in complex novel problem-solving conditions may prove to be difficult as they have engaged in a life-long process of skill mastery and expertise that promotes *specialization over generalization*. To promote novelty as the CALLA framework suggests is to overcome the motivational challenges of older adults' tendencies to focus on satisfying emotional more than new learning needs. That is, according to the socioemotional selectivity theory, as individuals' time horizons shrink, they are more motivated to pursue emotional needs than learning needs [Samanez-Larkin & Carstensen, 2011]. Moreover, evidence suggests that people become biased towards pursuing certainty as they age [Mather et al., 2012] – providing another barrier to exploring novel environments and skill development. Furthermore, neurobiological findings from a recent functional neuroimaging study suggest that older adults' tendency towards certainty over uncertainty may be partially due to natural aging as indexed by decreases in gray matter volume in the right posterior parietal cortex [Grubb, Tymula, Gilaie-Dotan, Glimcher, & Levy, 2016]. Together, interventions that incorporate principles of the CALLA framework may consider the motivational barriers of older adults towards certainty and away from learning and engaging in novel contexts.

Two of the six CALLA critical factors – growth mindset and serious commitment to learning – are related to the motivation obstacles described above. Overcoming these motivation and mindset obstacles will indeed be challenging for interventionists due to the dearth of empirical work on fostering growth mindset and seriousness of learning in older adults [Wu et al., 2016]. However, this could be viewed as a potential opportunity for researchers to generate novel empirical works to test the efficacy of the plasticity (or lack of plasticity) of fixed-growth mindsets and seriousness of learning in older adults. Moreover, this points to interventions to establish a purpose or basis on which to promote these two internal drive factors.

Opportunities for Leveraging Experience to Promote Broad Learning

One potential way to overcome the developmental challenges noted above is to capitalize on older adults' greatest strength and asset – their prior experiences, knowledge, and skills. Although the emphasis on novelty is important, so too is the role of

applying *experience*. The selection, optimization, and utilization of past experience, knowledge, and skills are at the cornerstone of the development of wisdom. The two most widely adopted models of wisdom are Sternberg's [1998] balance theory of wisdom and the Berlin wisdom paradigm [Baltes & Staudinger, 2000], defining wisdom as (a) applying practical intellect and *tacit knowledge* (holistic usage of knowledge, skills, and ideas) towards problem solving for the common good [Sternberg, 1998] and (b) applying expertise in the fundamental pragmatics of life, expertise meaning in *factual knowledge* about life matters, *procedural knowledge* to make decisions and resolve conflict, knowledge about life themes and contexts, knowledge about differences in goals and values, and understanding limits of own self-knowledge to deal with uncertainty [Baltes & Staudinger, 2000]. Although aging does not ensure that someone will apply wisdom effectively, interventions that hone the use of older adults' past experiences, knowledge, and skills that map onto relevant skills and knowledge improve the chance for them to earnestly participate and continue in cognitive engagement interventions [e.g., Carlson et al., 2008, 2009, 2015; Parisi et al., 2009; Rebok et al., 2011].

Novel Contexts + Applied Wisdom = Broad Learning

A formidable, but exciting challenge for cognitive engagement interventions is to design conditions that test older adults to apply their wisdom (experience, knowledge, and skills) in novel contexts. This objective is eloquently stated by Wu et al. [2016] as "harnessing the benefits from input- and knowledge-driven learning, while avoiding the costs of both" (p. 354).

One potential vehicle to harness both benefits from input- and knowledge-driven learning is to foster creative problem solving. Creativity refers to generating novel ideas, methods, and forms that are meaningful to others [Rank, Pace, & Frese, 2004]. Three factors that engender these creative environments are: (a) *intrinsic motivation* of a person towards achieving a purposeful goal, (b) contexts that are ever-changing and, (c) regular *adaptation of one's skills* to meet the demands of changing and complex environmental contexts [e.g., flow theory, Csikszentmihalyi, 1997].

Encore.org and now AAPR's Purpose Prize offer exemplary demonstrations of the intersection between creative problem solving through applied wisdom and novelty. The Purpose Prize is an annual award given to older adults who have created social change past the age of 60. These people have produced innovations – intentionally applied ideas, processes, products, or procedures, in relatively novel ways to significantly benefit the self or others [West & Farr, 1990]. Specifically, these individuals successfully produced some form of social change by developing new and honing existing knowledge, experience, and skills towards undertaking challenging societal issues (for more details see <http://encore.org/prize/>). While the Purpose Prize may not be sufficiently practical to implement on a large scale, the core idea of creating conditions that foster intrinsic motivation directed towards problem solving leverages skills and knowledge to meet challenges in new contexts.

Conclusion

The CALLA framework stimulates a shift to take steps towards a lifespan approach to understanding the efficacy of cognitive interventions in later life. Considering the conditions for intellectual stimulation and engagement early in life will help promote broad transfer learning in later life interventions. For the development of broad transfer learning, a change needs to occur to counterbalance the prolonged periods of life focused on near-learning (specialization). Moreover, the framework challenges theories and interventions on aging to focus beyond maintenance and compensation for loss and towards an emphasis on cognitive growth through variety of experience to promote neuroplasticity in later life. An emphasis on intervention conditions that are novel, challenging, and supportive while tailored to past experience, knowledge, and skills may represent the ideal combination of cognitive stimulation that will be sustained by the aging individual.

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