PEDAGOGICAL PSYCHOLOGY: BEYOND THE 21ST CENTURY

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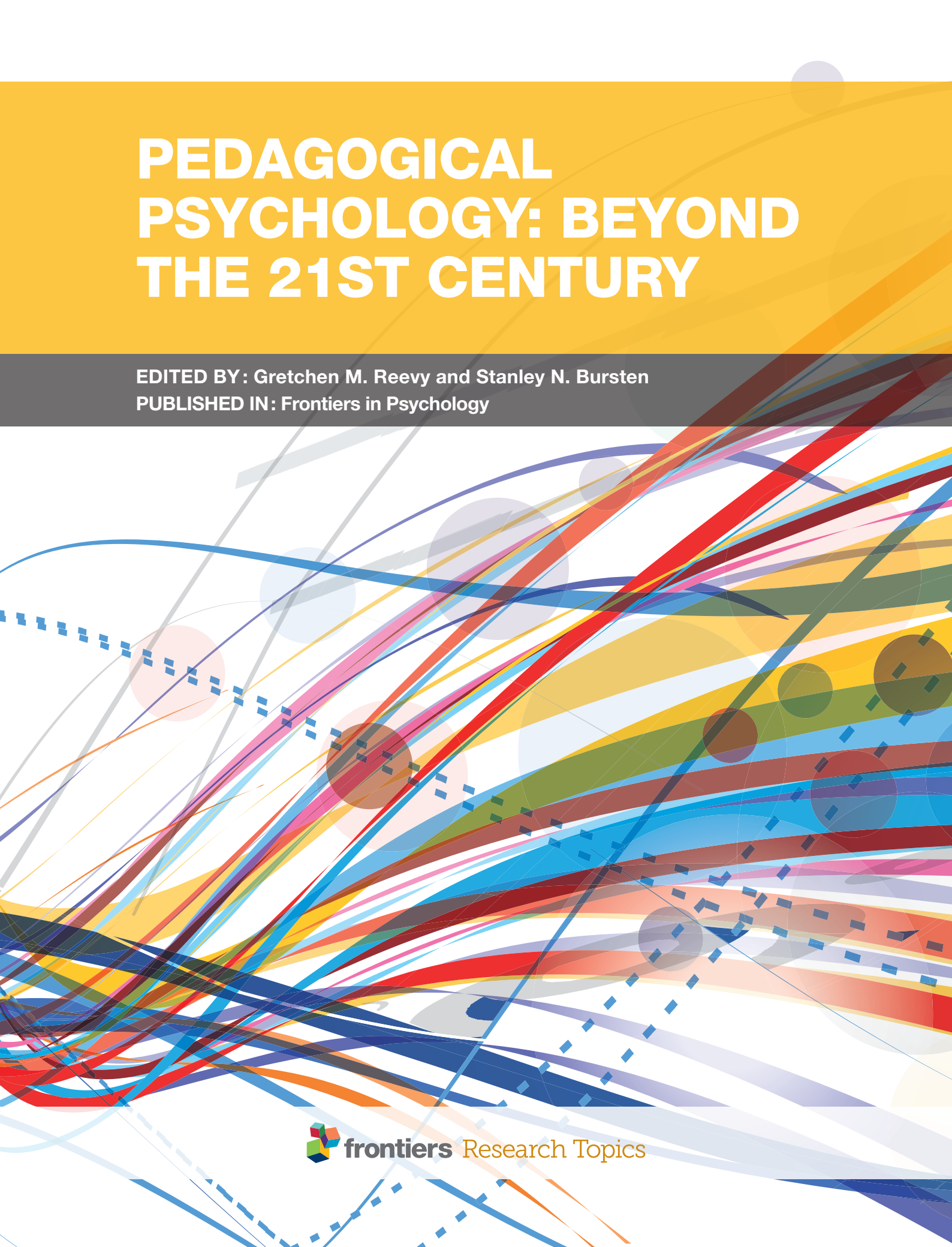

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PEDAGOGICAL PSYCHOLOGY: BEYOND THE 21ST CENTURY

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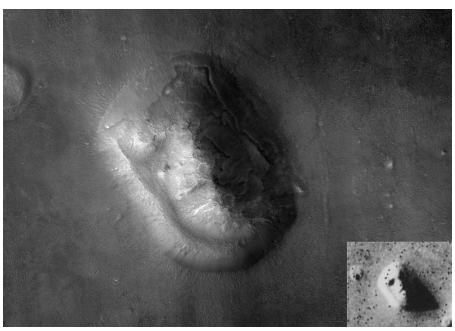

Pareidolia: The tendency to perceive meaningful images in meaningless visual stimuli.
Image by NASA/JPL/University of Arizona, http://commons.wikimedia.org/wiki/File:Face_on_Mars_with_Inset.jpg

During the 20th century, much of the teaching in higher education, especially at large universities and in particular disciplines, was accomplished through lecture. Additionally, theory and research in higher education pedagogy often focused on the teaching-by-lecture model. Given the heretofore unparalleled diversity that students bring to higher education, and the work and home life demands of some students, the lecture approach has often invested unrealistic responsibilities in, and unrealizable expectations on, both teachers and students. With the emergence of electronic data sharing (e.g., the Internet) and global cooperation/competition, newer approaches to teaching have begun to supplement and sometimes replace the older model of teaching. These newer approaches have simultaneously taken advantage of technological advances, global changes, and an evolving understanding of successful student-mentor relationships. As the pedagogical models driven by these changes evolve into the 22nd century and beyond, what seems groundbreaking today will, in hindsight, likely be seen as hidebound. Thus, the major goal of Pedagogical Psychology: Beyond the 21st Century was to publish manuscripts which imaginatively, but realistically anticipate future trends in teaching undergraduate psychology. The collection of papers in this volume achieve this goal and cover a variety of important areas: use of virtual agents or virtual reality in teaching, effective use of PowerPoint, online and hybrid (blended) classes, imaginative new methods of teaching critical thinking, use of contemplative exercises as a preparation for learning, how to adapt curriculum to meet new governmental standards for higher education, and implications of the dramatic increase in non-tenure-track faculty positions (and decrease in tenured or tenure-track positions) in higher education.

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EDITORIAL
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Pedagogical psychology: beyond the 21st century

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Keywords: education, teaching, intelligent virtual agents, neuroscience of learning, critical thinking, technology and pedagogy, online and hybrid delivery, faculty issues

The need of a society to educate its young in order to help them become valuable members of that society was likely recognized even before historical records began accumulating. The classic philosophers recognized this need even as they thought about other issues (Tweed and Lehman, 2002).

However, it appears that pedagogical theory has remained relatively stagnant, focusing on the teaching-by-lecture model until well into the 20th century (Landrum, 2009; Berrett, 2014). As governments and citizenry began realizing that older methods of education were not optimally preparing students to become productive and self-fulfilling members of society, societies began examining older approaches to education and new, hopefully more effective methods have been developed.

This special topic in *Frontiers in Educational Psychology* presents papers that exemplify only a few of the emerging theoretical and applied approaches toward pedagogy that aim to produce the competent graduates society expects from its learning institutions. Rather than focusing on pedagogical issues directly relevant to classic classroom content (e.g., basic skills, foundations of chemistry or history), the articles presented here focus on ideas which can form a basis for emerging and future applications. Thus, instead of bringing together articles which share an easily identifiable common theme, the articles in this issue are connected by an overarching goal—presenting new and sometimes untried approaches.

Several papers in this issue discuss the use of virtual agents or virtual reality in teaching. Macedonia, Groher, and Roithmayr show that second language instruction, particularly of vocabulary, can be more efficient through utilizing an intelligent virtual agent (IVA) than through using a human as the instructor. In an opinion piece, Repetto agrees with Macedonia et al. that IVAs are a promising vehicle for teaching second languages, and that the teaching and investigation of second language learning could be further enhanced through utilizing virtual reality. As Repetto describes, using virtual reality means that the learner is engaged in physical movement while learning, which bolsters memory. In a third paper Macedonia reviews research on use of gestures while learning the vocabulary of a second language, presenting evidence of the positive effects of movement while learning language. Although the articles focus on language learning, the principles described by these authors could apply to learning in other areas.

Schmaltz and Lilienfeld discuss an engaging way to teach critical thinking. They suggest presenting pseudoscience claims in class (e.g., paranormal phenomena), and then require that students closely examine these claims. By comparing pseudoscience claims with claims derived from scientific methods, students sharpen their critical thinking skills. Universities or government agencies in many nations now recognize critical thinking as an essential learning outcome for high school or college graduates [e.g., in the United States (Association of American Colleges and Universities, 2005) and Canada (Premier's Technology Council, 2010)]. In a novel approach, Binnun and Tarrasch describe a method for incorporating contemplative exercises, which they call "personal brain investigations" into a neuroscience course. They explain that

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some students in the humanities and social sciences have difficulty accepting some aspects of neuroscience, for instance, its reductionism; thus, adding an experiential component can enhance understanding and retention. The authors present survey results from students, revealing that many students reported satisfaction with the exercises, agreeing that the exercises produced benefits, such as discovery of new dimensions in relation to brain and mental processes.

Several papers address the growing use of technology to supplement and improve the traditional lecture. Gernsbacher describes the benefits of online courses over face-to-face. For instance, online courses can readily be designed to produce distributed learning, which leads to better mastery of course material. Van Doorn and Van Doorn's review presents a somewhat different perspective. The authors conclude that, in many cases, hybrid (blended) courses (which combine features of face-to-face and online) may be the best platform for many students, particularly non-traditional students. The authors also present a typology of the differing learning styles and needs of traditional and non-traditional students. Gernsbacher's and the Van Doorns' discussions are highly relevant in the 21st century; in 2013, one-third of university students in the United States took at least one online course (Allen and Seaman, 2013). Schmaltz and Enstrom describe how to most effectively use PowerPoint in teaching, explaining that university instructors are rarely taught how to use PowerPoint prior to entering the classroom.

In an opinion piece, Calder Stegemann discusses 21st century goals of teaching as identified by government agencies in Canada (e.g., Premier's Technology Council, 2010), and explains that pedagogical approaches to courses can be modified in order to achieve these new goals. Calder Stegemann specifically describes an approach to teaching educational psychology students. For instance, since a primary goal of educators is to teach students how to learn rather than to teach students information, instructors should devote more time to teaching students how to *acquire* information and less time to the dissemination of information (i.e., lecturing).

The final article, research by Reevy and Deason, is the only article in the issue which does not directly address pedagogy. Instead, the authors discuss an issue which is affecting the ability of higher education institutions to produce the most effective teaching methods: the employment contracts and working conditions of non-tenure-track (NTT) faculty who comprise the majority of faculty in higher education in the United States and other countries. Their study investigated relationships among working conditions, demographic and psychological variables, and measures of well-being in NTT faculty. They found that faculty with lower incomes, higher organizational commitment, and who desired a permanent position experienced elevated levels of depression, stress and anxiety. Since the goal of higher education is to produce the next generations of productive citizens, any variable that negatively impacts pedagogy must be addressed.

A number of societal factors including increasing technology, globalization, and neoliberalism have impacted all primary institutions in societies across the world. These factors have created both challenges to and opportunities for society's goal of educating our citizenry. The ideas and findings presented here in this special issue offer valuable contributions to the growing discussion about how we may best prepare the next generations of global citizens in the 21st century.

References

Allen, I. E., and Seaman, J. (2013). *Changing Course: Ten Years of Tracking Online Education in the United States*. Wellesley, MA: Babson College/Quahog Research Group.

Association of American Colleges and Universities. (2005). *The Essential Learning Outcomes.* Available online at: http://www.aacu.org/leap/vision.cfm (Retrieved December 31, 2014).

Berrett, D. (2014). Who's the hardest-working person in the lecture hall? Maybe it should no longer be the professor. *Chron. High. Edu.* 61:A14. Available online at: http://chronicle.texterity.com/chronicle/20141121a?folio=A14#pg14

Landrum, R. E. (2009). Faculty and student perceptions of providing instructor lecture notes to students: match or mismatch. *J. Instr. Psychol.* 37, 216–221. Available online at: http://scholarworks.boisestate.edu/psych_facpubs/26/

Premier's Technology Council. (2010). *A Vision for 21st Century Education*. BC: Government of British Columbia. Available online at: http://www.gov.bc.ca/premier/attachments/PTC_vision%20for_education.pdf (Accessed December 2014).

Tweed, R. G., and Lehman, D. R.(2002). Learning considered within a cultural context: confucian and Socratic approaches. *Am. Psychol.* 57, 89–99. doi: 10.1037//0003-066X.57.2.89

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Intelligent virtual agents as language trainers facilitate multilingualism

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In this paper we introduce a new generation of language trainers: intelligent virtual agents (IVAs) with human appearance and the capability to teach foreign language vocabulary. We report results from studies that we have conducted with Billie, an IVA employed as a vocabulary trainer, as well as research findings on the acceptance of the agent as a trainer by adults and children. The results show that Billie can train humans as well as a human teacher can and that both adults and children accept the IVA as a trainer. The advantages of IVAs are multiple. First, their teaching methods can be based on neuropsychological research findings concerning memory and learning practice. Second, virtual teachers can provide individualized training. Third, they coach users during training, are always supportive, and motivate learners to train. Fourth, agents will reside in the user's mobile devices and thus be at the user's disposal everywhere and anytime. Agents in apps will make foreign language training accessible to anybody at low cost. This will enable people around the world, including physically, financially, and geographically disadvantaged persons, to learn a foreign language and help to facilitate multilingualism.

Keywords: intelligent virtual agent, multilingualism, enactment effect, memory enhancement, mobile device

Everybody knows how tedious learning a foreign language can be, not only in school. Many of us have already quit a class in adult education because the teaching was inefficient or we did not study enough at home, or simply because we could not manage to get to the lessons on time. Nowadays more than ever, high proficiency in the world's major languages such as English and Spanish has become a must. However, formal instruction alone cannot provide adequate training for everybody. As a result, many students who graduate from high school cannot speak a lingua franca fluently enough to interact in business or science, or simply to acquire information from international media. In the future, intelligent virtual agents (IVAs) could provide what learners lack in formal instruction. Rigorous assessment of the effects of IVAs on learning can facilitate their introduction into learning environments.

VIRTUAL AGENTS CAN ALREADY TRAIN HUMANS ON VOCABULARY

In recent work we have focused on vocabulary learning as a first step toward foreign language acquisition (Bergmann and Macedonia, 2013). In our study, we have been employing the virtual human *Billie* (**Figure 1**), driven, technically speaking, by the AsapRealizer (Welbergen et al., 2012), which specifies the agent's behavior in Behavior Markup Language (BML) (Vilhjálmsson et al., 2007). BML coordinates speech, gesture, gaze, head and body movement. Thus, Billie, who looks like a young boy (thus pardon our personification), can show human-like behavior to a certain extent.

In his role as a vocabulary trainer, Billie enunciates words in a foreign language and at the same time performs iconic gestures representing the words (Bergmann et al., 2013). For example, for the word "book" his gesture simulates the opening of an imaginary book. Billie accompanies words with gestures because gestures enhance the retention of vocabulary. The enactment effect, i.e., the positive effect that gestures have on the memorization of verbal information, has been demonstrated in a number of experiments since the early eighties in research groups all over the world (see Zimmer, 2001, for a review). However, this knowledge has not been applied to foreign language vocabulary learning to any great extent. In the past decade only occasional studies have dealt with this topic (see Macedonia and Von Kriegstein, 2012, for a review). Educational practice still does not regard the body as a learning tool, although laboratory research has demonstrated that gestures support cognitive processes (Barsalou, 2008) and, in addition to language (Goldin-Meadow and Alibali, 2013), also enhance mathematical thinking and learning (Goldin-Meadow and LevineJacobs, 2014). This neglect of gestures persists despite the fact that second language practitioners have used self-performed pantomimes (Carels, 1981) and have been appraising the beneficial use of gestures in word learning since the eighteenth century (Radonvilliers, 1768).

In laboratory research, the enactment effect on memory has been explained in different terms, for example, as motoric imagery (Saltz and Donnenwerthnolan, 1981) or as a motor trace (Engelkamp and Zimmer, 1985) that complements the

FIGURE 1 | Screenshot of the virtual agent Billie.

word's representation in memory and makes it resistant to decay (Klimesch, 1994). Most interestingly, neuroscience has shown that learning words through enactment leads to the formation of extended memory networks, including canonical language areas of the brain as well as several visual, sensorimotor, and associative areas involved in the encoding process (Masumoto et al., 2006; Macedonia et al., 2011). These extended networks account for short- and long-term memory enhancement compared to audio-visual learning (reading and hearing). Thus, empirical results regarding enactment have revealed that the body can successfully be used as a learning tool and that sensorimotor learning is a superior alternative to audio-visual learning (Macedonia, 2013). For these reasons, Billie was modeled to serve as an instructor to teach users new words by means of enactment.

CAN A VIRTUAL AGENT BE A HELPFUL TEACHER?

In order to assess whether an agent can train learners as well as a human teacher can, we conducted a within-subjects behavioral study (Bergmann and Macedonia, 2013) in which both a human trainer and a virtual agent trained 29 students. They learned 36 words in Vimmi, an artificial corpus that conforms to Italian phonotactics. Vimmi was constructed for experimental purposes in order to avoid associations with languages known to participants. We cued subjects to listen, read, and repeat the words and to watch videos in which the agent or the human trainer performed iconic gestures. Participants had to perform the gestures demonstrated by both trainers. The overall memory results reflected higher scores when participants learned with Billie; however, the difference was not significant. Because individual performance showed high variance among subjects, we used the median to split the population into high and low performers. Surprisingly, for high performers the agent-based training proved to be significantly more successful than the training with the human teacher. In order to explain this effect, we acquired data to determine how the agent is perceived as a trainer. Naive participants who had not trained with the agent previously were asked to rate the gestures and the "personality" of both the IVA and the human. Participants rated the human gestures as significantly better than those of the agent (more fluent, etc.). Interestingly, the perception of the "personalities" of the human and the trainer did not differ greatly. The only difference was that participants rated the human trainer as significantly more intelligent than Billie. We attributed the results to factors that we summarized as the "bizarreness" of the trainer (Macedonia and Bergmann, in press).

In another study, we tested Billie's performance as a virtual vocabulary trainer for 44 school children of mean age 12 (Macedonia et al., in preparation). In this experiment, children were trained in the classroom according to three conditions. Children listened to Vimmi words that were read to them along with their translation into German (condition 1); children watched semantically related, i.e., iconic gestures performed by the IVA (condition 2), or did both and imitated the gestures (condition 3). The overall results show that watching the agent while performing an iconic gesture significantly enhances word memorization compared to audio-visual learning. However, significantly better results were obtained when children imitated the agent, i.e., performed the gestures themselves.

In a further study (Macedonia et al., in preparation), we assessed the attitude of 12-year-old children toward IVAs. Similarly to the study with adults reported above (Macedonia and Bergmann, in press), this investigation was designed to determine how children perceived the gestures and the personality of the agent. Twenty-two school children age 11 were shown 15 gestures (videos) performed by both Billie and by a 12-year-old boy. The children were asked to rate the quality of the gestures and some of the personality traits (i.e., sympathy, friendliness, and intelligence) of both the agent and the child. The human gestures were rated as better than those produced by the IVA, as in the study with adults. However, the children did not perceive any significant difference in the sympathy and the intelligence of the human and the agent. Again, this behavioral study shows that children (at least this sample) also accept an IVA.

In summary, experiments conducted so far with the virtual agent Billie have demonstrated that he can train humans to learn vocabulary items as well as a human trainer. This is the case both for adults trained in a lab and for children trained in a classroom. In addition, we have shown that memory results improve if learners perform the gestures themselves instead of only watching the IVA perform them. Further, both young adults and children demonstrate good acceptance of the virtual trainer.

AGENTS WILL BECOME INTELLIGENT AND SERVE AS INDIVIDUALIZED PERSONAL TRAINERS

In the experiments described above, the agent was not intelligent and did not interact with the users. The IVA did not provide feedback on gesture and pronunciation performance. However, as these experiments focused on learning with gestures, feedback would have represented an additional variable biasing the results. In fact, feedback does have an influence on motivation (Hattie, 2011; Busse, 2013) and consequently on learning. Recently this has also been demonstrated with respect to human/machine interaction. In a study by Mumm and Mutlu (2011), 192 participants were engaged in a speed-reading task; verbal feedback from the computer and the presence of a virtual agent on the screen positively influenced their task persistence. The authors conclude that both feedback and the agent enhanced motivation.

Because gesture performance leads to better results, participants must be instructed not only to perform the gestures but also to execute them accurately. We have observed (anecdotal evidence) that during training learners tend to reduce the gestures and/or omit them. In order to monitor learners, the agent must recognize motions performed by the user. Different technologies that enable recognition (Biswas and Basu, 2011; Ozcelik and Sengul, 2012) already exist and can be applied. The intelligent agent then compares the user's gestures with a template and allows a certain degree of deviation. If deviation surpasses a threshold, information is conveyed in spoken form, for example: "You did not move your right arm the way I told you to." Monitoring each user's gestures ensures that learners enact the words in the most appropriate manner. This is necessary in order to create stable experience-dependent sensorimotor networks in their brains (Kiefer et al., 2007) that retain the foreign words. Furthermore, in order to train users to pronounce words like natives do, automatic speech-recognition software (ASR) can provide guidance. ASR systems detect differences in pronunciation from those in stored native speaker templates (Ma et al., 2012). If the deviation of the learner surpasses a threshold, the agent recognizes this and can trigger corrective feedback similar to the gesture correction. Corrective feedback from the agent involving both speech and facial expression animate the user to do better (Tung, 2011). ASRs are already in use, and their positive effects on motivation and achievement were recently reviewed (Golonka et al., 2012).

Another major issue concerning the development of IVAs is their customization to a user's special needs. During the experimental training described above, Billie taught participants without taking their intellectual capacities or their learning progress into account. The agent offered standardized training with a certain number of repetitions for all of the words. This training was inflexible and in a certain sense also inefficient. Some users might need more repetitions, while others might require fewer. It has been demonstrated that high performers who learn with gestures activate their brain resources differently than low performers do (Macedonia et al., 2010). This, in turn, leads to differences in learning achievement. Besides, some words might be easier for one person to learn than for another.

Hence, it is necessary to integrate all of this information into the training scheme provided to each individual user. An IVA will thus devise a standard cognitive profile, taking into account age, working memory performance, level of attention, education, and a few other parameters that are important in foreign language learning, such as cognitive control (Abutalebi et al., 2012) and bilingualism, as well as impeding factors such as dyslexia (Callens et al., 2012). The agent will then evaluate the frequency and duration of the training and match them with the learning results. Furthermore, the agent will calculate a standard deviation from the expected standard results for each particular learner. On this basis, the IVA will determine the amount of training (number of repetitions, frequency of training, etc.) that is necessary for any individual user. The longer the agent collects data on the user, the more finely the training can be tuned to individual needs. In this way, low and high performers can be challenged individually: frustration will be reduced but, most importantly, skills and capabilities will be enhanced.

Another aspect that needs to be implemented in the agent's interaction is personalized emotional supportive feedback. Whereas a human trainer can show differences in mood as well as sympathy or antipathy toward a person, an IVA will never do so. The agent's attitude toward the user will always be positive and appreciating and manifested by the absence of negative elements in communication. However, the agent will also be modeled to take the user's emotional state into account. Besides automatic speech recognition, new software enables an agent to detect changes in the pitch and tone of the voice that denote emotion (Ramakrishnan and Emary, 2013; Rao et al., 2013; Lech and He, 2014). Furthermore, empathy models that recognize negative emotional states in the user (Boukricha et al., 2013) will be implemented. This will enable the machine to generate adequate verbal support, so that the agent can interact with the user in a sensitive and personalized way.

AGENT APPLICATION AND FUTURE GLOBAL CONTRIBUTION FOR SOCIETY

Of course, IVAs will not be confined to desktops waiting for the user to come home and train. Instead, as applications they will accompany users in their mobile devices wherever they go. All the burdens connected with getting from home or from an office to classes, struggling through traffic jams and finding a parking space will be eliminated. Users will then rationally use their time to do what they need to do: learn the foreign language. IVAs will also fulfill their ultimate goal: to train the users at any time of the day or night, whenever they want to use them. A further advantage of IVAs will be their low cost. For the price of a fast food meal or probably even less, users from all social classes and with all levels of income will be able to enjoy personalized instruction designed according to neuroscientific findings and tailored to their individual cognitive capacities and needs.

The challenges for the future are manifold. First, every step in the development of IVAs must be validated with experiments reflecting the impact of agent-guided instruction on the user's cognitive performance. In other words, statistical evidence rather than descriptive theory must be the basis for pedagogical practice. Secondly, after vocabulary learning, syntax, and morphology will have to follow and be incorporated into the design of the language competence of the virtual trainer.

IVAs as language instructors are no longer a mere vision: in the past 10 years, basic research in cognition and neuroscience has paved a new avenue for instruction. Furthermore, artificial intelligence and technology have laid the foundations for novel applications in the interaction between humans and information systems. However, the work has been done in different fields of research. Presently we are connecting the dots, defining interfaces between disciplines, and creating interdisciplinary and international task forces to enable researchers with different backgrounds and skills to contribute to the development of IVAs that are capable of serving as foreign language instructors.

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REFERENCES

Abutalebi, J., Della Rosa, P. A., Green, D. W., Hernandez, M., Scifo, P., Keim, R., et al. (2012). Bilingualism tunes the anterior cingulate cortex for conflict monitoring. *Cereb. Cortex* 22, 2076–2086. doi: 10.1093/cercor/bhr287

Barsalou, L. W. (2008). Grounded cognition. *Annu. Rev. Psychol.* 59, 617–645. doi: 10.1146/annurev.psych.59.103006.093639

Bergmann, K., Kahl, S., and Kopp, S. (2013). "Modeling the semantic coordination of speech and gesture under cognitive and linguistic constraints," in *Intelligent Virtual Agents*, eds R. Aylett, B. Krenn, C. Pelachaud, and H. Shimodaira (Berlin; Heidelberg: Springer), 203–216.

Bergmann, K., and Macedonia, M. (2013). "A virtual agent as vocabulary trainer: iconic gestures help to improve learners' memory performance," in *Intelligent Virtual Agents,* eds R. Aylett, B. Krenn, C. Pelachaud, and H. Shimodaira (Berlin; Heidelberg: Springer), 139–148.

Biswas, K. K., and Basu, S. K. (2011). "Gesture recognition using Microsoft Kinect®," in *2011 5th International Conference on Automation, Robotics and Applications (ICARA)*, (Wellington), 100–103.

Boukricha, H., Wachsmuth, I., Carminati, M., and Knoeferle, P. (2013). "Empathy and its modulation in a virtual human," in *KI 2013: Advances in Artificial Intelligence,* eds I. Timm and M. Thimm (Berlin; Heidelberg: Springer), 25–36.

Busse, V. (2013). How do students of German perceive feedback practices at university? A motivational exploration. *J. Second Lang. Writ.* 22, 406–424. doi: 10.1016/j.jslw.2013.09.005

Callens, M., Tops, W., and Brysbaert, M. (2012). Cognitive profile of students who enter higher education with an indication of dyslexia. *PLoS ONE* 7:e38081. doi: 10.1371/journal.pone.0038081

Carels, P. E. (1981). Pantomime in the foreign-language classroom. *Foreign Lang. Ann.* 14, 407–411. doi: 10.1111/j.1944-9720.1981.tb01660.x

Engelkamp, J., and Zimmer, H. D. (1985). Motor programs and their relation to semantic memory. *Ger. J. Psychol.* 239–254.

Goldin-Meadow, S., and Alibali, M. W. (2013). Gesture's role in speaking, learning, and creating language. *Annu. Rev. Psychol.* 64, 257–283. doi: 10.1146/annurev-psych-113011-143802

Goldin-Meadow, S., Levine, and Jacobs, S. (2014). "Gestures role in learning arithmetic," in *Emerging Perspectives on Gesture and Embodiment in Mathematics*, eds L. Edwards, F. Ferrara, and D. Moore-Russo (Charlotte, NC: Information Age Publishing). (in press).

Golonka, E. M., Bowles, A. R., Frank, V. M., Richardson, D. L., and Freynik, S. (2012). Technologies for foreign language learning: a review of technology types and their effectiveness. *Comput. Assist. Lang. Learn.* 27, 70–105. doi: 10.1080/09588221.2012.700315

Hattie, J. (2011). Visible learning: a synthesis of over 800 meta-analyses relating to achievement. *Int. Rev. Educ.* 57, 219–221. doi: 10.1007/s11159-011-9198-8

Kiefer, M., Sim, E.-J., Liebich, S., Hauk, O., and Tanaka, J. (2007). Experience-dependent plasticity of conceptual representations in human sensory-motor areas. *J. Cogn. Neurosci.* 19, 525–542. doi: 10.1162/jocn.2007.19.3.525

Klimesch, W. (1994). *The Structure of Long-Term Memory: a Connectivity Model of Semantic Processing*. Hillsdale, NJ: Erlbaum.

Lech, M., and He, L. (2014). "Stress and emotion recognition using acoustic speech analysis," in *Mental Health Informatics*, eds M. Lech, I. Song, P. Yellowlees, and J. Diederich (Berlin; Heidelberg: Springer), 163–184.

Ma, Y., Paulraj, M. P., Yaacob, S., Shahriman, A. B., and Nataraj, S. K. (2012). "Speaker accent recognition through statistical descriptors of Mel-bands spectral energy and neural network model," in *2012 IEEE Conference on Sustainable Utilization and Development in Engineering and Technology (STUDENT),* (Kuala Lumpur), 262–267.

Macedonia, M. (2013). Learning a second language naturally: the voice movement icon approach. *J. Educ. Dev. Psychol.* 3, 102–116. doi: 10.5539/jedp.v3n2p102

Macedonia, M., and Bergmann, K. (in press). A bizarre pedagogical virtual trainer enhances memory for words in a foreign language. *Int. J. Comp. Sci. Artif. Intell.*

Macedonia, M., Müller, K., and Friederici, A. D. (2010). Neural correlates of high performance in foreign language vocabulary learning. *Mind Brain Educ.* 4, 125–134. doi: 10.1111/j.1751-228X.2010.01091.x

Macedonia, M., Müller, K., and Friederici, A. D. (2011). The impact of iconic gestures on foreign language word learning and its neural substrate. *Hum. Brain Mapp.* 32, 982–998. doi: 10.1002/hbm.21084

Macedonia, M., and Von Kriegstein, K. (2012). Gestures enhance foreign language learning. *Biolinguistics* 6, 393–416.

Masumoto, K., Yamaguchi, M., Sutani, K., Tsuneto, S., Fujita, A., and Tonoike, M. (2006). Reactivation of physical motor information in the memory of action events. *Brain Res.* 1101, 102–109. doi: 10.1016/j.brainres.2006.05.033

Mumm, J., and Mutlu, B. (2011). Designing motivational agents: the role of praise, social comparison, and embodiment in computer feedback. *Comput. Hum. Behav.* 27, 1643–1650. doi: 10.1016/j.chb.2011.02.002

Ozcelik, E., and Sengul, G. (2012). Gesture-based interaction for learning: time to make the dream a reality. *Br. J. Educ. Technol.* 43, E86–E89. doi: 10.1111/j.1467-8535.2012.01288.x

Radonvilliers, C. F. L. D. (1768). *De la Manieľre d'Apprendre les Langues.* Paris: Saillant.

Ramakrishnan, S., and Emary, I. M. (2013). Speech emotion recognition approaches in human computer interaction. *Telecommun. Syst.* 52, 1467–1478. doi: 10.1007/s11235-011-9624-z

Rao, K. S., Koolagudi, S. G., and Vempada, R. R. (2013). Emotion recognition from speech using global and local prosodic features. *Int. J. Speech Technol.* 16, 143–160. doi: 10.1007/s10772-012-9172-2

Saltz, E., and Donnenwerthnolan, S. (1981). Does motoric imagery facilitate memory for sentences - a selective interference test. *J. Verbal Learn. Verbal Behav.* 20, 322–332. doi: 10.1016/S0022-5371(81)90472-2

Tung, F.-W. (2011). Effects of emotional feedback on children, using different modalities. *Interact. Learn. Environ.* 21, 3–17. doi: 10.1080/10494820.2010.542758

Vilhjálmsson, H., Cantelmo, N., Cassell, J., E. Chafai, N., Kipp, M., Kopp, S., et al. (2007). "The behavior markup language: recent developments and challenges," in *Intelligent Virtual Agents,* eds C. Pelachaud, J.-C. Martin, E. André, G. Chollet, K. Karpouzis, and D. Pelé (Berlin; Heidelberg: Springer), 99–111.

Welbergen, H., Reidsma, D., and Kopp, S. (2012). "an incremental multimodal realizer for behavior co-articulation and coordination," in *Intelligent Virtual Agents,* eds Y. Nakano, M. Neff, A. Paiva, and M. Walker (Berlin; Heidelberg: Springer), 175–188.

Zimmer, H. D. (2001). *Memory for Action: A Distinct Form of Episodic Memory?* Oxford: Oxford University Press.

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The use of virtual reality for language investigation and learning

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Virtual Reality (VR) is a technological tool traditionally used in psychology for clinical purposes or self-empowerment: a huge number of papers have documented the validity of treatments provided or supported by VR. Most of these have illustrated protocols for the treatment of anxiety disorders: from simple phobias (Krijn et al., 2007), to panic disorders (Botella et al., 2007), post-traumatic stress disorder (Gerardi et al., 2008), and generalized anxiety disorder (Repetto et al., 2009, 2013b; Repetto and Riva, 2011); recently, VR has also been effectively employed for stress management in a non-clinical population (Gaggioli et al., 2014).

However, in the last decades, growing attention has been dedicated to this tool in the field of neuroscience (Bohil et al., 2011) for the study of spatial navigation, multisensory integration, social neuroscience, pain remediation, or neurorehabilitation. Macedonia et al. (2014) took a step in this direction, using one of the VR basic elements for the investigation of language learning. In particular, they built Intelligent Virtual Avatars (IVAs) with human appearance and assigned them the task to teach a second language to different trainee populations (adults and children). The authors evaluated the results of their studies and discussed two levels of outcome: memory performance, and IVAs' acceptability.

IVAs proved to be as effective as their human counterparts at teaching capabilities; learners memorized new words better when they performed an iconic gesture associated to the word than when they only watched the teacher performing the same gesture, whether the teacher was virtual or human. This finding can easily be interpreted within the framework of Embodied Cognition Theory (Barsalou, 2008): according to this theory, the cognitive system is no longer considered as a processor of symbols and abstract operations, but is deemed to be grounded in multimodal representations molded from human experience. In this view, cognitive processes, including language, are "embodied" in nature, since the perceptual and motor systems influence the way we construct concepts, make inferences and use language. Several proofs of this claim have been provided in the neuroscience literature: it has been found that the primary motor cortex is involved in language comprehension (Repetto et al., 2013a), and that the same neural structures needed to process sensory information are also active when processing words that embed that sensory information, such as color (Martin et al., 1995).

Considering these recent findings, the use of VR in the study of language processes becomes even more reasonable. In fact, VR can be considered an "embodied technology" for its effects on body perceptions (Riva, 2002): it is possible to use VR to induce controlled changes to the experience of the body; furthermore, the virtual environment can be enriched to the extent that it can become a plausible copy of the real world.

The first feature seems very important in the study of foreign language learning: if the association of a gesture to a word can enhance verbal memory (Macedonia et al., 2011), then VR offers a privileged medium in which to implement the training. In fact, it gives users the opportunity to see themselves moving in the environment while being comfortably seated in a chair. Thanks to different input devices, participants could virtually perform any action, even those typically not performable in an experimental or learning setting (e.g., kick a ball). Thus, future research could combine the use of IVAs with the possibility for the learners to see themselves performing the gesture illustrated by the IVA: for instance, if kicking a ball is the action to imitate, the user (by manipulating a joypad) could see in the VR his own leg and foot raising up and hitting a ball. Recently, a virtual environment (Riva et al., 2009) was employed for the study of language learning and comprehension; preliminary results pointed out that, in second language learning tasks, a virtual motion (a motion performed in the virtual world with a body part that is actually steel) associated to action words can enhance verbal memory if the environment is perceived as true-to-life. Logically, in native language tasks, the virtual action can promote language comprehension (papers in preparation).

Similarly, the possibility to create very detailed environments can support the study of language: if representations in the cognitive system are multimodal, then to investigate their properties one should recreate the multimodal experience that can trigger the process. Thus, in the future, navigation in high-quality virtual worlds, associated with the execution of gestures or actions, could possibly create the optimum experience to improve the

processing of words, helping trainees to learn (in case of new language acquisition) or re-learn/consolidate information (just think about the rehabilitation of language abilities in aphasic patients). New research is needed to investigate the efficacy of these trainings, and the findings by Macedonia (Macedonia et al., 2014) testify that this line of research deserves further efforts.

As far as the IVAs' acceptability is concerned, Macedonia's data seem to support the idea that, in general, both adults and younger trainees accepted the avatar Billie as a language teacher. Addressing the issue of acceptability brings us to the concept of "uncanny valley" (Mori et al., 2012). According to Mori, the acceptability of a virtual character is not a linear function of its human likeness. In other words, the more a virtual agent resembles a human being, the more it is acceptable, until it reaches a certain degree of likeness: at this point, it is perceived as "uncanny," losing credibility and appeal. Acceptability rises again when the level of likeness exceeds this critical point, making the character almost identical to the human form. It should be noticed that the uncanny valley effect represents a potential risk for the effectiveness of training: if the trainee recognizes the virtual agent as uncanny, he/she may be less willing to adhere to the agent's instructions, or to the training itself. Apparently, this was not the case in Macedonia's research. In fact, recent new findings have called the uncanny valley effect into question. For example, a recent study by Piwek (Piwek et al., 2014) highlighted the fact that the motion quality of a full-body animated avatar can influence the acceptability of the IVA: the characters classified in the deepest location of the uncanny valley in their static form, were judged later on as more acceptable when motion was added. This result seems to indicate that motion *per se* may help to bypass the uncanny valley. Nevertheless, the evaluation of the agent acceptability appears mandatory: when building an experiment that includes IVAs, especially for psychological investigations, researchers routinely should run pre-tests that take into account the threat of the uncanny valley effect.

In conclusion, Macedonia and colleagues opened new promising paths for the study of language learning, by combining neuroscientific knowledge and new frontiers of technology that can help address new questions, and by building powerful tools for the improvement of language abilities; the future direction is to refine the paradigms taking advantage of all the capabilities that VR offers.

REFERENCES

Barsalou, L. W. (2008). Grounded cognition. *Annu. Rev. Psychol.* 59, 617–645. doi: 10.1146/annurev.psych.59.103006.093639

Bohil, C. J., Alicea, B., and Biocca, F. A. (2011). Virtual reality in neuroscience research and therapy. *Nat. Rev. Neurosci.* 12, 752–762. doi: 10.1038/nrn3122

Botella, C., García-Palacios, A., Villa, H., Baños, R. M., Quero, S., Alcañiz, M., et al. (2007). Virtual reality exposure in the treatment of panic disorder and agoraphobia: a controlled study. *Clin. Psychol. Psychother.* 14, 164–175. doi: 10.1002/cpp.524

Gaggioli, A., Pallavicini, F., Morganti, L., Serino, S., Scaratti, C., Briguglio, M., et al. (2014). Experiential virtual scenarios with real-time monitoring (interreality) for the management of psychological stress: a block randomized controlled trial. *J. Med. Internet Res.* 16:e167. doi: 10.2196/jmir.3235

Gerardi, M., Rothbaum, B. O., Ressler, K., Heekin, M., and Rizzo, A. (2008). Virtual reality exposure therapy using a virtual Iraq: case report. *J. Trauma. Stress* 21, 209–213. doi: 10.1002/jts.20331

Krijn, M., Emmelkamp, P. M., Olafsson, R. P., Bouwman, M., Van Gerwen, L. J., Spinhoven, P., et al. (2007). Fear of flying treatment methods: virtual reality exposure vs. cognitive behavioral therapy. *Aviat. Space Environ. Med.* 78, 121–128.

Macedonia, M., Groher, I., and Roithmayr, F. (2014). Intelligent virtual agents as language trainers facilitate multilingualism. *Front. Psychol.* 5:295. doi: 10.3389/fpsyg.2014.00295

Macedonia, M., Muller, K., and Friederici, A. D. (2011). The impact of iconic gestures on foreign language word learning and its neural substrate. *Hum. Brain Mapp.* 32, 982–998. doi: 10.1002/hbm.21084

Martin, A., Haxby, J. V., Lalonde, F. M., Wiggs, C. L., and Ungerleider, L. G. (1995). Discrete cortical regions associated with knowledge of color and knowledge of action. *Science* 270, 102–105. doi: 10.1126/science.270.5233.102

Mori, M., Macdorman, K. F., and Kageki, N. (2012). The uncanny valley [from the field]. *IEEE Rob. Autom. Mag.* 19, 98–100. doi: 10.1109/MRA.2012.2192811

Piwek, L., McKay, L. S., and Pollick, F. E. (2014). Empirical evaluation of the uncanny valley hypothesis fails to confirm the predicted effect of motion. *Cognition* 130, 271–277. doi: 10.1016/j.cognition.2013.11.001

Repetto, C., Colombo, B., Cipresso, P., and Riva, G. (2013a). The effects of rTMS over the primary motor cortex: the link between action and language. *Neuropsychologia* 51, 8–13. doi: 10.1016/j.neuropsychologia.2012.11.001

Repetto, C., Gaggioli, A., Pallavicini, F., Cipresso, P., Raspelli, S., and Riva, G. (2013b). Virtual reality and mobile phones in the treatment of generalized anxiety disorders: a phase-2 clinical trial. *Pers. Ubiquit. Comput.* 17, 253–260. doi: 10.1007/s00779-011-0467-0

Repetto, C., Gorini, A., Algeri, D., Vigna, C., Gaggioli, A., and Riva, G. (2009). The use of biofeedback in clinical virtual reality: the intrepid project. *Stud. Health Technol. Inform.* 144, 128–132. doi: 10.3233/978-1-60750-017-9-128

Repetto, C., and Riva, G. (2011). From virtual reality to interreality in the treatment of anxiety disorders. *Neuropsychiatry* 1, 31–43. doi: 10.2217/npy.11.5

Riva, G. (2002). Virtual reality for health care: the status of research. *Cyberpsychol. Behav.* 5, 219–225. doi: 10.1089/109493102760147213

Riva, G., Carelli, L., Gaggioli, A., Gorini, A., Vigna, C., Algeri, D., et al. (2009). NeuroVR 1.5 in practice: actual clinical applications of the open source VR system. *Stud. Health Technol. Inform.* 144, 57–60. doi: 10.3233/978-1-60750-017-9-57

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Bringing back the body into the mind: gestures enhance word learning in foreign language

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Foreign language education in the twenty-first century still teaches vocabulary mainly through reading and listening activities. This is due to the link between teaching practice and traditional philosophy of language, where language is considered to be an abstract phenomenon of the mind. However, a number of studies have shown that accompanying words or phrases of a foreign language with gestures leads to better memory results. In this paper, I review behavioral research on the positive effects of gestures on memory. Then I move to the factors that have been addressed as contributing to the effect, and I embed the reviewed evidence in the theoretical framework of embodiment. Finally, I argue that gestures accompanying foreign language vocabulary learning create embodied representations of those words. I conclude by advocating the use of gestures in future language education as a learning tool that enhances the mind.

Keywords: language learning, gesture, embodiment and grounded cognition, memory, education methods, brain

INTRODUCTION

In western countries, foreign language (L2) lessons employ mainly audio-visual learning (Choo et al., 2012; Graham et al., 2014). Novel vocabulary items are embedded in texts and/or missing in texts with gaps; during reading or listening, learners fill the gaps. At home, learners go through bilingual lists and read them as often as they need to in order to memorize the words (Yamamoto, 2014). As everybody has experienced, vocabulary learning is tedious and lists must be relearned regularly in order to build up the word inventory that we need for speaking.

In the 1970s Piaget noted that native language (L1) acquisition is a sensorimotor process (Piaget, 1976). Today, findings in cognitive sciences show that word learning is a process involving multisensory perception and motor acts (Tomasello, 2005; Goldin-Meadow and Alibali, 2013). In other words, word learning involves the body in cognition. Why then does language education continue to teach vocabulary mainly by hearing and reading?

The dichotomy between body and mind goes back to Descartes. In his *Discourse on the Method* (Descartes, 1637), he postulated the division between the body (with material properties and working as a machine) and what is intangible, the mind, both interacting but remaining strictly separated. In this sense, a cognitive capacity like language would be served by the body but belong to the mind. This perspective held for over two centuries. In the 1970s/1980s it was reinforced by Fodor's influential theories (Fodor, 1976, 1987), which see language input and output as separated from the system ruling them at the base of cognitive capacity. Whereas input (hearing) and output (speaking) are sensorial, hence modal – similar to Descartes (1637), provided by the "machine" – language belongs to an abstract functional system (Pylyshyn, 1984). The rules of this system, like syntactic rules, are amodal and symbolic. Along this line of thought, semantics is also abstract: words are symbols for objects and events in the real world. Turning its back on structuralism (de Saussure, 1916), modern second language instruction found nourishing substrate in Fodor's ideas and Chomsky's linguistic theory (Chomsky, 1965, 1975), which again proposed language as an abstract and innate phenomenon of the mind, unrelated to the body (Ewing, 1972). With this theoretical background, second language instruction has concentrated on building up language in a similar way as it was thought that L1 acquisition occurs (Cook, 2004), i.e., by providing learners with authentic text materials (Gilmore, 2007), listening and comprehension activities (Macaro, 2006), intuitive procedures, and implicit rule acquisition (Rebuschat and Williams, 2012). Over time, it seems that memory and how to optimize vocabulary acquisition have not been considered as relevant issues in theories of language education. In spite of that, in practice, the need to acquire vocabulary has always been a core concern for teachers and learners (Coady and Huckin, 1997). This explains the large amount of vocabulary teaching materials (Davidson, 2007; Nation, 2008; Schmitt, 2008; Meara, 2009; McCarthy et al., 2010) and vocabulary games (Ghanbaran and Ketabi, 2014) published for the classroom.

GESTURES AND MEMORY FOR WORDS AND PHRASES IN L2

The first scholar reporting about the positive effect of gestures on vocabulary retention was Radonvilliers (1768). In his book, he compared L1 with L2 learning. He noted that when explaining the word *lion* to a child in L1, an adult would show a picture or perform some illustrative gesture of the concept, whereas in L2 this does not happen. About two centuries later, Asher (1969) described the Total Physical Response approach, where learners

responded to commands in L2 such as *close the door* by performing the action. Asher (1969) noticed that memory for the phrase was enhanced if learners combined action and phrase. However, Asher (1969) did not investigate his observation empirically and his work did not go beyond a theoretical position in language education. In memory research, the 1980s were a fertile decade for those research groups that tested the effect of gestures on the retention of words and phrases in the subject's L1. The *enactment effect* (Engelkamp, 1980) or *subject performed task effect* (Cohen, 1981) was documented (Hehtrup, 1994) as robust across different populations and by different kinds of tests (see Zimmer, 2001 for a review). Note, however, that this research did not affect linguistic theory and most interestingly never reached L2 education, where, practice of vocabulary learning worked with complex elaboration of texts, flash cards and different kinds of visual learning materials in order to enhance memory for words (Clark and Paivio, 1991; Paivio, 1991). Still, the body was not taken into consideration as a learning tool.

Quinn-Allen (1995) conducted the first empirical study on the influence of gestures on memory for L2. She taught English natives short sentences in French by means of reading. For half of the sentences, subjects additionally performed cultural gestures illustrating the sentence's semantics. Quinn-Allen (1995) found better memory results for enacted phrases in the short- and the long-term. In her doctoral dissertation, Macedonia (2003) taught German-speaking university students words of an artificial corpus audio-visually and additionally by performing a gesture. The artificial corpus was used in order to avoid associations with languages known to participants. In cued recall tests, memory performance was significantly superior for enacted items at all time points, i.e., on days 1 and 8, but also on days 15 and 73 and after 14 months. Tellier (2008) taught French pre-schoolers English words. Half of the group learned the lexical items with pictures. The other half of the group learned them by self-performing iconic gestures. Significantly better memorization was obtained through gestures. Kelly et al. (2009) worked with English natives. They learned Japanese verbs audio-visually and additionally by performing an iconic gesture. A portion of the words was accompanied by congruent gestures, the other by incongruent gestures not reflecting the word's semantics. Congruent gestures led to better results. Macedonia et al. (2011) cued participants to accompany concrete words of an artificial corpus either with illustrative or with meaningless gestures. Memory results were significantly better for words learned with illustrative gestures in the short- and the long-term (60 days). These findings also hold for abstract words learned not isolated but embedded in sentences, as documented in a further study by Macedonia and Knösche (2011). Porter (2012) explored the effects of gestures on memory during French lessons with English children (5–7 years); two stories were told: one with pictures and one with both gestures and pictures. Again, gestures enhanced memory. Mayer et al. (2014) had participants learn novel words of an artificial corpus either by pairing them to a picture or to a gesture. Gestures could be of two kinds: iconic gestures or gestures produced by drawing the outline of the concept in the air. Compared to the baseline (reading and hearing), performing gestures was more efficient than learning with pictures. In the long-term, words learned through iconic gestures scored better than drawing their semantic shape in the air. Recently, enactment was tested with an intelligent agent as a trainer, i.e., a virtual figure with anthropomorphic appearance. The agent cued learners to perform gestures while learning words in L2 (Macedonia et al., 2014b). The first of these studies compared memory enhancement between a baseline (reading and hearing the words) and additionally performing an iconic gesture. Young adults were presented the words and the gestures either by a human or by an agent trainer. Independently of the trainer, gestures led to memory enhancement (Bergmann and Macedonia, 2013). Another study with school children enriched the audio-visual baseline by observation or observation coupled with performance of the gesture produced by a virtual agent. The results demonstrated that self-performance of the gesture is the key to enhanced learning (Macedonia et al., 2014a).

The effect of gestures on memory for words and phrases in L2 is robust and well documented. Few studies report finding no behavioral enhancement of memory (Krönke et al., 2013; Rowe et al., 2013). However, learning is a dynamic process elicited through input. The input is affected by a number of parameters that differ in most studies presented in this review. Following factors can bias results in a word-learning experiment: the phonotactic shape of the words (Baddeley et al., 1975; Gathercole and Baddeley, 1992), word familiarity (Meier et al., 2013), number of repetitions, cognitive capacities of the population (Macedonia et al., 2010), and so on. Considering the many experiments providing evidence *for* the enactment effect, the studies above might have affected these parameters in a way that enactment could not have an impact on learning performance.

FACTORS LEADING TO MEMORY ENHANCEMENT FOR WORDS IN L2

Over the decades, the enactment effect has been explained in a number of ways. The first explanation addressed the concept of memory trace. Considering that overt performance of the gesture leads to enhancement, Engelkamp (1980) and Engelkamp and Zimmer (1985) attributed the enhancement to the creation of a motor trace. This view was confirmed many years later in neuroscientific studies documenting that audio-visual perception of words learned with gestures elicit activity in brain regions controlling motion (Masumoto et al., 2006; Macedonia et al., 2011). Considering that enactment is a multisensory process, enhancement was also attributed to the complexity of the memory trace (Tellier, 2008; Porter, 2012). This position also holds in various neuroscientific studies; for a review, see Horchak et al. (2014). Other studies explained the effect through depth of encoding (Quinn-Allen, 1995; Tellier, 2008; Kelly et al., 2009; Macedonia et al., 2011; Krönke et al., 2013; Macedonia and Klimesch, 2014), with this concept going back to Craik and Lockhart's (1972) influential model, which suggested that information is processed at different levels, sensory information, for example hearing, being shallow and semantic processing being deep. A further factor addressed as leading to memory enhancement is mental imagery (Kelly et al., 2009; Macedonia and Knösche, 2011; Macedonia et al., 2011), where learners performing a gesture would activate

an internal kinetic image of the concept/word. Support for this view comes from a review by Hostetter and Alibali (2008). There the authors propose that gestures emerge from an underlying mental image of concepts and therefore are tightly connected to them. Recently, in this line of thought, an intriguing view was presented by Straube et al. (2012), i.e., a supra-modal network in the brain serving both speech and gesture semantics.

These different approaches are not mutually exclusive. Rather, they shed light on multiple facets of enactment. On the one hand, they explain the creation of memory representation; on the other hand, they address the interconnectedness of language and gesture, hence the particular relationship between them.

WORDS AND THE BODY

In traditional linguistics, a word was regarded as an abstract unit of the mental lexicon (Aitchison, 1987). However, neuroscientific studies in the past decades have demonstrated that a word (in the brain's language) is an experience-dependent functional network (Pulvermuller, 1999). This network consists of interconnected neuron assemblies in regions of the brain involved in the learning process (Kiefer and Pulvermüller, 2012; Moseley and Pulvermüller, 2014). Consider the word *cinnamon*. When a child acquires the label for the concept, i.e., the word, the child collects multisensory experience reflecting his/her interaction with the spice: olfactory and gustatory perception, consistency to the touch, visual characteristics, motor programs to interact with the spice and to articulate the word, sequence of phonemes, and so on. Through literacy, this network is enlarged by the written word (**Figure 1**). Neuroscientific experiments demonstrate that by activating a component of the network, other components become active and respond on stimulation. For example, mere reading of the word *cinnamon* activates the network and those brain regions processing odor and taste even if the person in the scanner cannot smell or taste cinnamon (González et al., 2006; Barros-Loscertales et al., 2012).

Similarly, verbs describing actions (such as *kick*, *lick*, and *pick*) involve representations in the brain of those body parts used to perform the action (e.g., foot, tongue, and hand; Hauk et al., 2004). Hearing the (learned) word is enough to activate brain regions that command those body parts (see Fischer and Zwaan, 2008; Watson et al., 2013, for reviews).

The principle of the network holds not only for concrete and action words, but also for abstract words. Expectedly, emotional words are strongly linked to emotional regions in the brain (Straube et al., 2011; Citron, 2012) but more interestingly to motor regions as well (Moseley et al., 2012), the latter possibly being involved during actions that accompany emotional states (Vigliocco et al., 2009). Other abstract words, depending on their emotional valence, activate an emotional network in the brain, as recently demonstrated in a functional magnetic resonance study by Vigliocco et al. (2014). Altogether, these findings provide converging evidence against symbolic theories of language. Instead, these findings show that in the brain (hence in cognition) words are represented in an experience-related way and this experience is connected to the body (Glenberg and Kaschak, 2002; Barsalou, 2008; Fischer and Zwaan, 2008).

Furthermore, being language grounded in the body and its actions, mere reading or hearing elicits simulation. Simulation, in

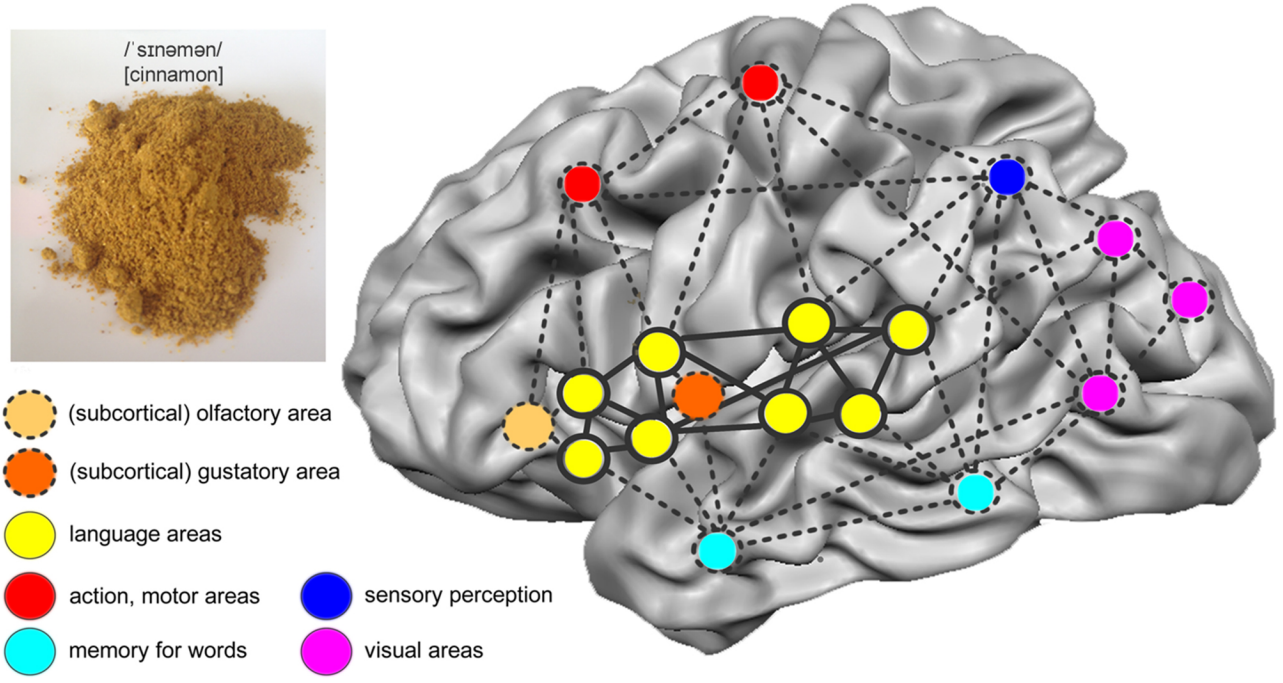

FIGURE 1 | Word network for cinnamon. It comprises canonical language areas, areas processing and storing sensorial information experienced (visual features, odor, taste, color, texture, etc.), and motor areas involved in preparation and execution of action for manipulation and gustation of the spice.

turn, induces brain activity in those areas that are activated during physical performance.

EMBODIMENT OF FOREIGN LANGUAGE WORDS

Understanding words in L1 reactivates experience-dependent representations in the brain (Glenberg and Gallese, 2012). Recent studies have investigated whether embodiment of language is limited to L1 or also extended to L2. Dudschig et al. (2014) hypothesized that perceiving words in L2 might also trigger motor responses similarly to L1. They presented German subjects English words such as *star* and *root* that are spatially located either above or under the subject. The subjects were asked to respond to the words with an upward or a downward arm movement. Reaction times were collected. The statistical analysis showed no differences in reaction times between native and L2. The authors take these results as evidence for the existence of sensorimotor representation for words in second language. In a reaction time experiment, Vukovic and Williams (2014) made highly bilingual Dutch subjects studying in the United Kingdom read English sentences with interlingual homophones. The task implied a distance relation. A picture followed each sentence. Subjects had to provide an answer that either matched or mismatched the distance relation. Again, the reaction time results showed that subjects, when hearing the homophones, must have simulated the word's semantics for both L1 and L2. In a functional magnetic resonance imaging study, De Grauwe et al. (2014) made German subjects read motor verbs in Dutch, their L2. The items were subdivided in two categories: cognate (words with a similar phonetic shape and the same meaning) and non-cognate verbs. Both cognate and non-cognate verbs activated motor-related areas in the brain. These studies provide initial evidence for the existence of embodied lexical representations also in L2. The processing of such words occurs in an automatic and unconscious way, like in L1. However, *advocatus diaboli* might argue in the case of Vukovic and Williams (2014) study that results hold for highly proficient bilinguals, i.e., for learners that have collected enough sensorimotor experience for the vocabulary through full immersion. Also, cognate words might represent a special class of words with high embodiment. It is questionable whether somebody learning a new language by reading and hearing would show the same reactions when asked to perform the tasks reported in the experiment. More research is needed in order to discern how L2 words become embodied.

Here, we wonder how in L2 gestures contribute to mapping concepts into the body. In the light of the preceding sections, we presently reason that:

1. Gestures, here specifically actions, as described in Asher (1969), performed during novel L2-word learning (e.g., German *gehen*, English *to go*, by English learners) connect to a pre-existing embodied representation(s) in the learners' L1. Also, it is possible that *gehen* creates its own sensorimotor representation in a similar way as in L1;
2. In the case of a word that cannot be represented by an action (e.g., English *bridge* or *thought)*, an illustrative (iconic) gesture might match an internal kinetic image of the word previously created in L1, therefore connect the L2 word and the embodied representation on a more abstract level. The existence of an internal image applying also for L2 has been demonstrated in a brain imaging study. In this study, upon word recognition, incongruent gestures performed to L2 words elicited a Stroop-task-like network in the brain denoting disturbance (Macedonia et al., 2011);
3. For function words (e.g., *already* or *although*), gestures can only be symbolic and arbitrary, as proposed by Macedonia and Knösche (2011). In that study, gestures enhanced learning. However, it still has to be demonstrated whether these gestures do create a novel embodied representation in L1, as those words are highly abstract.

More empirical research is needed in order to turn speculations into knowledge. However, the foundation of a new vision of language instruction grounded in the learner's body has been laid.

CONCLUSION

In the past two decades, amodal theories of language have been massively challenged through progress in neuroscience. Empirical evidence has shown that language learning and representation are intrinsically connected to the body. This evidence has given birth to various theories of embodiment that are still being discussed in the light of empirical findings (see Meteyard et al., 2012; Horchak et al., 2014, for reviews). Independently of this, embodiment is giving language education a cutting edge by authorizing it to consider the body as a learning tool. In the future this will hopefully enable learners to exploit natural and L1-like strategies and to improve L2 word acquisition (Macedonia, 2013). In a few years we will have a more comprehensive picture of language as an embodied cognitive capacity. Recent research also considers that language needs both the body but also abstract symbols (Arbib et al., 2014). However, after decades of symbolism, it is the body's turn in L2 vocabulary learning!

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REFERENCES

Aitchison, J. (1987). *Words in the Mind: an Introduction to the Mental Lexicon*. Oxford: Basil Blackwell.

Arbib, M. A., Gasser, B., and Barrès, V. (2014). Language is handy but is it embodied? *Neuropsychologia* 55, 57–70. doi: 10.1016/j.neuropsychologia.2013.11.004

Asher, J. J. (1969). The total physical response technique of learning. *J. Spec. Educ.* 3, 253–262. doi: 10.1177/002246696900300304

Baddeley, A., Thompson, N., and Buchanan, M. (1975). Word length and the structure of memory. *J. Verbal Learn. Verbal Behav.* 14, 575–589. doi: 10.1016/S0022-5371(75)80045-4

Barros-Loscertales, A., Gonzalez, J., Pulvermuller, F., Ventura-Campos, N., Bustamante, J. C., Costumero, V., et al. (2012). Reading salt activates gustatory brain regions: fMRI evidence for semantic grounding in a novel sensory modality. *Cereb. Cortex* 22, 2554–2563. doi: 10.1093/cercor/bhr324

Barsalou, L. W. (2008). Grounded cognition. *Annu. Rev. Psychol.* 59, 617–645. doi: 10.1146/annurev.psych.59.103006.093639

Bergmann, K., and Macedonia, M. (2013). "A virtual agent as vocabulary trainer: iconic gestures help to improve learners' memory performance," in *Intelligent Virtual Agents, Lecture Notes in Artificial Intelligence*, eds R. Aylett, B. Krenn, C. Pelachaud, and H. Shimodaira (Berlin: Springer), 139–148.

Chomsky, N. (1965). *Syntactic Structures*. The Hague: Mouton.

Chomsky, N. (1975). *Reflections on Language*. New York, NY: Pantheon Books.

Choo, L. E. E. B., Tan Ai Lin, D., and Pandian, A. (2012). Language learning approaches: a review of research on explicit and implicit learning in vocabulary acquisition. *Procedia Soc. Behav. Sci.* 55, 852–860. doi: 10.1016/j.sbspro.2012.09.572

Citron, F. M. M. (2012). Neural correlates of written emotion word processing: a review of recent electrophysiological and hemodynamic neuroimaging studies. *Brain Lang.* 122, 211–226. doi: 10.1016/j.bandl.2011.12.007

Clark, J., and Paivio, A. (1991). Dual coding theory and education. *Educ. Psychol. Rev.* 3, 149–210. doi: 10.1007/BF01320076

Coady, J., and Huckin, T. N. (1997). *Second Language Vocabulary Acquisition: A Rationale for Pedagogy*. Cambridge: Cambridge University Press.

Cohen, R. L. (1981). On the generality of some memory laws. *Scand. J. Psychol.* 22, 267–281. doi: 10.1111/j.1467-9450.1981.tb00402.x

Cook, V. (2004). "Linguistics and second language acquisition: one person with two languages," in *The Handbook of Linguistics*, eds M. Aronoff and J. Rees-Miller (Oxford: Blackwell Publishing), 488–511.

Craik, F. I. M., and Lockhart, R. S. (1972). Levels of processing: a framework for memory research. *J. Verbal Learn. Verbal Behav.* 11, 671–684. doi: 10.1016/S0022-5371(72)80001-X

Davidson, P. (2007). *Teaching and Learning Vocabulary in Another Language*. Dubai: TESOL Arabia.

De Grauwe, S., Willems, R. M., Rueschemeyer, S.-A., Lemhöfer, K., and Schriefers, H. (2014). Embodied language in first- and second-language speakers: neural correlates of processing motor verbs. *Neuropsychologia* 56, 334–349. doi: 10.1016/j.neuropsychologia.2014.02.003

de Saussure, F. (1916). *Cours de linguistique générale*. Lausanne: Bally & Séchehaye.

Descartes, R. (1637). *The Discourse on Method and Metaphysical Meditations*. London: Walter Scott.

Dudschig, C., De La Vega, I., and Kaup, B. (2014). Embodiment and second-language: automatic activation of motor responses during processing spatially associated L2 words and emotion L2 words in a vertical Stroop paradigm. *Brain Lang.* 132, 14–21. doi: 10.1016/j.bandl.2014.02.002

Engelkamp, J. (1980). Some studies on the internal structure of propositions. *Psychol. Res.* 41, 355–371. doi: 10.1007/BF00308880

Engelkamp, J., and Krumnacker, H. (1980). Imaginale und motorische Prozesse beim Behalten verbalen Materials. *Z. Exp. Angew. Psychol.* 28, 511–533.

Engelkamp, J., and Zimmer, H. D. (1985). Motor programs and their relation to semantic memory. *German J. Psychol.* 28, 239–254.

Ewing, W. K. (1972). The mentalist theory of language learning. *Foreign Lang. Ann.* 5, 455–462. doi: 10.1111/j.1944-9720.1972.tb00709.x

Fischer, M. H., and Zwaan, R. A. (2008). Embodied language: a review of the role of the motor system in language comprehension. *Q. J. Exp. Psychol.* 61, 825–850. doi: 10.1080/17470210701623605

Fodor, J. A. (1976). *The Language of Thought.* Hassocks: Harvester Press.

Fodor, J. A. (1987). *Psychosemantics: The Problem of Meaning in the Philosophy of Mind*. Cambridge, MA: MIT Press.

Gathercole, S. E., and Baddeley, A. D. (1992). *Working Memory and Language*. Hove: Lawrence Erlbaum.

Ghanbaran, S., and Ketabi, S. (2014). Multimedia games and vocabulary learning. *Theory Pract. Lang. Stud.* 4, 489–496.

Gilmore, A. (2007). Authentic materials and authenticity in foreign language learning. *Lang. Teach.* 40, 97–118. doi: 10.1017/S0261444807004144

Glenberg, A. M., and Gallese, V. (2012). Action-based language: a theory of language acquisition, comprehension, and production. *Cortex* 48, 905–922. doi: 10.1016/j.cortex.2011.04.010

Glenberg, A. M., and Kaschak, M. P. (2002). Grounding language in action. *Psychon. Bull. Rev.* 9, 558–565. doi: 10.3758/BF03196313

Goldin-Meadow, S., and Alibali, M. W. (2013). Gesture's role in speaking, learning, and creating language. *Annu. Rev. Psychol.* 64, 257–283. doi: 10.1146/annurev-psych-113011-143802

González, J., Barros-Loscertales, A., Pulvermüller, F., Meseguer, V., Sanjuán, A., Belloch, V., et al. (2006). Reading cinnamon activates olfactory brain regions. *Neuroimage* 32, 906–912. doi: 10.1016/j.neuroimage.2006.03.037

Graham, S., Santos, D., and Francis-Brophy, E. (2014). Teacher beliefs about listening in a foreign language. *Teach. Teach. Educ.* 40, 44–60. doi: 10.1016/j.tate.2014.01.007

Hauk, O., Johnsrude, I., and Pulvermuller, F. (2004). Somatotopic representation of action words in human motor and premotor cortex. *Neuron* 41, 301–307. doi: 10.1016/S0896-6273(03)00838-9

Hehtrup, T. (1994). Nyberg, Lars: the enactment effect: studies of a memory phenomenon. *Scand. J. Psychol.* 35, 91–92. doi: 10.1111/j.1467-9450.1994.tb00936.x

Horchak, O. V., Giger, J.-C., Cabral, M., and Pochwatko, G. (2014). From demonstration to theory in embodied language comprehension: a review. *Cogn. Syst. Res.* 29–30; 66–85. doi: 10.1016/j.cogsys.2013.09.002

Hostetter, A. B., and Alibali, M. W. (2008). Visible embodiment: gestures as simulated action. *Psychon. Bull. Rev.* 15, 495–514. doi: 10.3758/PBR.15.3.495

Kelly, S. D., Mcdevitt, T., and Esch, M. (2009). Brief training with co-speech gesture lends a hand to word learning in a foreign language. *Lang. Cogn. Process.* 24, 313–334. doi: 10.1080/01690960802365567

Kiefer, M., and Pulvermüller, F. (2012). Conceptual representations in mind and brain: theoretical developments, current evidence and future directions. *Cortex* 48, 805–825. doi: 10.1016/j.cortex.2011.04.006

Krönke, K.-M., Mueller, K., Friederici, A. D., and Obrig, H. (2013). Learning by doing? The effect of gestures on implicit retrieval of newly acquired words. *Cortex* 49, 2553–2568. doi: 10.1016/j.cortex.2012.11.016

Macaro, E. (2006). Strategies for language learning and for language use: revising the theoretical framework. *Mod. Lang. J.* 90, 320–337. doi: 10.1111/j.1540-4781.2006.00425.x

Macedonia, M. (2003). *Sensorimotor Enhancing of Verbal Memory through "Voice Movement Icons" During Encoding of Foreign Language* (German: *Voice Movement Icons. Sensomotorische Encodierungsstrategie zur Steigerung der quantitativen und qualitativen Lerneffizienz bei Fremdsprachen*). Ph.D. thesis, University of Salzburg, Salzburg.

Macedonia, M. (2013). Learning a second language naturally: the voice movement icon approach. *J. Educ. Dev. Psychol.* 3, 102–116. doi: 10.5539/jedp.v3n2p102

Macedonia, M., Bergmann, K., and Roithmayr, F. (2014a). Imitation of a pedagogical agent's gestures enhances memory for words in second language. *Sci. J. Edu.* 2, 141–145. doi: 10.11648/j.sjedu.20140205.15

Macedonia, M., Groher, I., and Roithmayr, F. (2014b). Intelligent virtual agents as language trainers facilitate multilingualism. *Front. Psychol.* 5:295. doi: 10.3389/fpsyg.2014.00295

Macedonia, M., and Klimesch, W. (2014). Long-term effects of gestures on memory for foreign language words trained in the classroom. *Mind Brain Educ.* 8, 74–88. doi: 10.1111/mbe.12047

Macedonia, M., and Knösche, T. R. (2011). Body in mind: how gestures empower foreign language learning. *Mind Brain Educ.* 5, 196–211. doi: 10.1111/j.1751-228X.2011.01129.x

Macedonia, M., Müller, K., and Friederici, A. D. (2010). Neural correlates of high performance in foreign language vocabulary learning. *Mind Brain and Educ.* 4, 125–134. doi: 10.1111/j.1751-228X.2010.01091.x

Macedonia, M., Müller, K., and Friederici, A. D. (2011). The impact of iconic gestures on foreign language word learning and its neural substrate. *Hum. Brain Mapp.* 32, 982–998. doi: 10.1002/hbm.21084

Masumoto, K., Yamaguchi, M., Sutani, K., Tsuneto, S., Fujita, A., and Tonoike, M. (2006). Reactivation of physical motor information in the memory of action events. *Brain Res.* 1101, 102–109. doi: 10.1016/j.brainres.2006.05.033

Mayer, K. M., Yildiz, I. B., Macedonia, M., and Von Kriegstein, K. (2014). Motor and visual brain areas support foreign language word learning. *Curr. Biol.* (in press).

McCarthy, M., O'Keeffe, A., and Walsh, S. (2010). *Vocabulary Matrix: Understanding, Learning, Teaching*. Andover: Heinle, Cengage Learning.

Meara, P. M. (2009). *Connected Words: Word Associations and Second Language Vocabulary Acquisition*. Philadelphia: John Benjamins Publishing Company.

Meier, B., Rey-Mermet, A., Rothen, N., and Graf, P. (2013). Recognition memory across the lifespan: the impact of word frequency and study-test interval on estimates of familiarity and recollection. *Front. Psychol.* 4:787. doi: 10.3389/fpsyg.2013.00787

Meteyard, L., Cuadrado, S. R., Bahrami, B., and Vigliocco, G. (2012). Coming of age: a review of embodiment and the neuroscience of semantics. *Cortex* 48, 788–804. doi: 10.1016/j.cortex.2010.11.002

Moseley, R., Carota, F., Hauk, O., Mohr, B., and Pulvermüller, F. (2012). A role for the motor system in binding abstract emotional meaning. *Cereb. Cortex* 22, 1634–1647. doi: 10.1093/cercor/bhr238

Moseley, R. L., and Pulvermüller, F. (2014). Nouns, verbs, objects, actions, and abstractions: local fMRI activity indexes semantics, not lexical categories. *Brain Lang.* 132, 28–42. doi: 10.1016/j.bandl.2014.03.001

Nation, I. S. P. (2008). *Teaching Vocabulary: Strategies and Techniques*. Boston, MA: Heinle.

Paivio, A. (1991). *Images in Mind: the Evolution of a Theory*. New York: Harvester Wheatsheaf.

Piaget, J. (1976). "Piaget's theory," in *Piaget and His School*, eds B. Inhelder, H. Chipman, and C. Zwingmann (Berlin: Springer), 11–23.

Porter, A. (2012). A helping hand with language learning: teaching French vocabulary with gesture. *Lang. Learn. J.* 1–21. doi: 10.1080/09571736.2012.750681

Pulvermuller, F. (1999). Words in the brain's language. *Behav. Brain Sci.* 22, 253–279; discussion 280–336. doi: 10.1017/S0140525X9900182X

Pylyshyn, Z. W. (1984). *Computation and Cognition: Toward a Foundation for Cognitive Science*. Cambridge, MA: MIT Press.

Quinn-Allen, L. (1995). The effects of emblematic gestures on the development and access of mental representations of french expressions. *Mod. Lang. J.* 79, 521–529. doi: 10.1111/j.1540-4781.1995.tb05454.x

Radonvilliers, C. F. L. D. (1768). *De la Manieľre d'Apprendre les Langues*. Paris: Saillant.

Rebuschat, P., and Williams, J. N. (2012). Implicit and explicit knowledge in second language acquisition. *Appl. Psycholinguist.* 33, 829–856. doi: 10.1017/S0142716411000580

Rowe, M. L., Silverman, R. D., and Mullan, B. E. (2013). The role of pictures and gestures as nonverbal aids in preschoolers' word learning in a novel language. *Contemp. Educ. Psychol.* 38, 109–117. doi: 10.1016/j.cedpsych.2012.12.001

Schmitt, N. (2008). Review article: instructed second language vocabulary learning. *Lang. Teach. Res.* 12, 329–363. doi: 10.1177/1362168808089921

Straube, B., Green, A., Weis, S., and Kircher, T. (2012). A supramodal neural network for speech and gesture semantics: an fMRI study. *PLoS ONE* 7:e51207. doi: 10.1371/journal.pone.0051207

Straube, T., Sauer, A., and Miltner, W. H. R. (2011). Brain activation during direct and indirect processing of positive and negative words. *Behav. Brain Res.* 222, 66–72. doi: 10.1016/j.bbr.2011.03.037

Tellier, M. (2008). The effect of gestures on second language memorisation by young children. *Gesture* 8, 219–235. doi: 10.1075/gest.8.2.06tel

Tomasello, M. (2005). *Constructing a Language: A Usage-Based Theory of Language Acquisition*. Cambridge, MA: Harvard University Press.

Vigliocco, G., Kousta, S.-T., Della Rosa, P. A., Vinson, D. P., Tettamanti, M., Devlin, J. T., et al. (2014). The neural representation of abstract words: the role of emotion. *Cereb. Cortex* 24, 1767–1777. doi: 10.1093/cercor/bht025

Vigliocco, G., Meteyard, L., Andrews, M., and Kousta, S. (2009). Toward a theory of semantic representation. *Lang. Cogn.* 1, 219–247. doi: 10.1515/LANGCOG.2009.011

Vukovic, N., and Williams, J. N. (2014). Automatic perceptual simulation of first language meanings during second language sentence processing in bilinguals. *Acta Psychol.* 145, 98–103. doi: 10.1016/j.actpsy.2013.11.002

Watson, C. E., Cardillo, E. R., Ianni, G. R., and Chatterjee, A. (2013). Action concepts in the brain: an activation likelihood estimation meta-analysis. *J. Cogn. Neurosci.* 25, 1191–1205. doi: 10.1162/jocn_a_00401

Yamamoto, Y. (2014). Multidimensional vocabulary acquisition through deliberate vocabulary list learning. *System* 42, 232–243. doi: 10.1016/j.system.2013.12.005

Zimmer, H. D. (2001). *Memory for Action: A Distinct Form of Episodic Memory?* Oxford: Oxford University Press.

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Hauntings, homeopathy, and the Hopkinsville Goblins: using pseudoscience to teach scientific thinking

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With access to information ever increasing, it is essential that students acquire the skills to distinguish fact from fiction. By incorporating examples of pseudoscience into lectures, instructors can provide students with the tools needed to understand the difference between scientific and pseudoscientific or paranormal claims. We discuss examples involving psychics, ghosts, aliens, and other phenomena in relation to scientific thinking. In light of research literature demonstrating that presenting and dispelling scientific misconceptions in the classroom is an effective means of countering non-scientific or pseudoscientific beliefs, we provide examples of pseudoscience that can be used to help students acquire healthy skepticism while avoiding cynicism.

Keywords: scientific thinking, skepticism, pseudoscience, teaching resources, introductory psychology

From Dr. Oz promoting homeopathy to Deepak Chopra extolling the virtues of quantum healing, students are bombarded with questionable claims that require careful examination. Although students have access to more information than ever before, many do not possess the skills to distinguish good information from bad. Exacerbating this problem is the prevalence of pseudoscientific information available in the popular media, online, and even the classroom (Lilienfeld et al., 2004; Losh and Nzekwe, 2011; Novella, 2013). The purpose of this article is to provide examples that challenge students and provide instructors with tools to enhance scientific thinking. To do so, we describe how to distinguish science from pseudoscience, and provide several examples that can be used to promote scientific thinking. Specifically, we want to encourage students to employ *scientific skepticism*. Scientific skepticism means approaching claims with an open mind, and a willingness to accept only those claims that have survived scrutiny in rigorous scientific tests (Sagan, 1995). Skepticism differs from cynicism, which implies close-mindedness to novel claims. Through unique class demonstrations, assignments, and lecture material, instructors can use pseudoscience as a vehicle to engage students and foster scientific skepticism (see Stanovich, 2012 as a valuable resource).

Teaching scientific methods and the nature of science alone is not sufficient to help students distinguish science from pseudoscience. Data from educational psychology suggest that unless misconceptions are addressed explicitly in coursework, they will frequently persist (e.g., Winer et al., 2002). Overcoming students' naïve scientific beliefs is a significant challenge for educators, as researchers have found that these beliefs can endure even after the acquisition of incompatible scientific theories (Shtulman and Valcarcel, 2012). In a survey of 10,000 American students over a 20-year period, there was only a modest decline in pseudoscientific beliefs following an undergraduate degree, even for students who had taken two or three science courses (Impey et al., 2012). At the same time, there is hope. Researchers have found that short-term skeptical thinking improves among students who have had direct exposure to the refutation of pseudoscientific claims (Kowalski and Taylor, 2009; Manza et al., 2010), although long-term follow-ups are needed to corroborate these findings. Incorporating examples of scientific misconceptions in lectures can be a valuable tool for science educators to help students overcome erroneous scientific beliefs and distinguish science from pseudoscience (see Lilienfeld et al., 2001 for a brief review of the literature).

SCIENCE vs. PSEUDOSCIENCE

The distinction between science and pseudoscience is not clear-cut. The demarcation problem – the hoary question of how science differs from pseudoscience or non-science – can lead to fruitful class discussion (see Pigliucci and Boudry, 2013, for a thorough overview of the demarcation problem). Although this problem has not be definitively resolved, it can be helpful to provide a set of warning signs that indicate a claim may be pseudoscientific (for a review of the warning signs of pseudoscience, see Lilienfeld et al., 2012). From this perspective, science and pseudoscience differ in degree, not kind, but they often can be differentiated by means of a number of fallible, but useful, indicators (Stanovich, 2012). Some of these key warning signs are:

- *The use of psychobabble – words that sound scientific, but are used incorrectly, or in a misleading manner.* For example, "energy therapies" for psychological problems are often premised on biofeedback, meridian lines, quantum energies, and a host of other concepts that may sound impressive, but lack evidence.
- *A substantial reliance on anecdotal evidence.* Evidence for pseudoscience is typically anecdotal and consequently difficult to verify. For a class example, instructors may want to show students the Q-Ray bracelet website[1] and read the many quotes

[1] www.qray.com

submitted by Q-Ray users. Although the quotes sound compelling, there is no scientific evidence to support any claims attached to them. In fact, the Q-Ray company lost a lawsuit in 2011 and was ordered to refund over $11 million dollars to people who purchased a Q-Ray bracelet.

- *Extraordinary claims in the absence of extraordinary evidence* (Truzzi, 1978; Sagan, 1995). In pseudosciences, assertions are often highly implausible in light of existing knowledge yet are not backed by convincing evidence. For a class example, instructors may wish to describe how infomercials promoting Q-Ray bracelets state that the "bracelet rips [pain] right out of the body[2]." and are "designed to optimize your natural positive energy[1]."
- *Unfalsifiable claims* – Most pseudoscientific claims are incapable of being refuted in principle. For example, proponents of traditional Chinese medicine (TCM) believe the human body has an invisible energy force called Qi (Zollman and Vickers, 1999). Qi is a crucial component of TCM, even though it cannot be measured or tested scientifically.
- *An absence of connectivity to other research* (Stanovich, 2010). Connectivity refers to the extent to which assertions build on extant knowledge. For example, homeopathic practitioners state that homeopathic treatments become stronger as they become more dilute, and that water has memory. Both of these claims run counter to established scientific knowledge (Singh and Ernst, 2008).
- *Absence of adequate peer review.* Peer review is far from perfect, but it is a key safeguard against error. Instructors may wish to encourage students to contrast the claims advanced by the authors of peer-reviewed versus non-peer-reviewed articles.
- *Lack of self-correction.* Pseudosciences frequently persist despite refutation. Often, proponents of pseudoscience will use the idea that since the treatment or idea has been used for thousands of years it must be correct (e.g., astrology), an error often called the ad antiquetem fallacy (or, argument from antiquity).

One starting point to help students differentiate science from pseudoscience is to discuss the frequent misuse of quantum physics by proponents of the paranormal. *The Secret* (Byrne, 2006) may be one "secret" to starting students on their journey to become better scientific thinkers.

THE LAW OF ATTRACTION AND QUANTUM PHYSICS

Rhonda Byrne's best-selling book *The Secret* (Byrne, 2006), based on the film of the same name, promotes the "law of attraction." The basic tenet of this law is that like attracts like. This means that if we want something in our lives, we simply need to focus our thoughts on that object and it will come to us. Proponents of *The Secret* claim that the law of attraction works through sending out frequencies to the universe. This is explained through a misrepresentation of quantum physics and assorted psychobabble. A short video available on YouTube[3] delineates the basic tenets of *The Secret*.

A useful class exercise is to allow students to watch the video and then attempt to devise an experiment to test the law of attraction. Students will start to grapple with issues of falsifiability and connectivity. *The Secret* is also an excellent tool to address such topics as psychobabble, how extraordinary claims require extraordinary evidence, and the need to investigate the reliability of the source when investigating claims (e.g., "Dr." Joe Vitale has a Ph.D. from the online, unaccredited University of Metaphysics).

Instructors can provide a number of resources that fit the model of *The Secret*, such as QuantumMAN downloadable medicine[4]. QuantumMAN is an online resource whereby people can pay to download digital "medicine" that ostensibly cures everything from the common cold to malaria. Downloadable medicine supposedly "transfers from a remote quantum computer to your brain's neural network for the benefits desired[4]." The website is an ideal tool to discuss pseudoscience, as it encapsulates nearly all signs of pseudoscience.

PSYCHICS AND SPOON BENDING

Students come into introductory psychology courses with many misconceptions about the field and science in general. One of the myths that many students hold is the idea that we only use 10% of our brain (for an overview of the myths of psychology, see Lilienfeld et al., 2010). Accessing the remaining 90% will supposedly lead to superior intelligence, and possibly even psychic abilities (Beyerstein, 1999). One of the proponents of the 10% myth is spoon-bending "mystifier" Uri Geller (Randi, 1982a). Geller rose to fame in the 1970s and was best known for his ability to bend metal by harnessing the remaining 90% of his brain.

A useful classroom demonstration is for the instructor to claim psychic abilities by bending spoons, supposedly using only the power of the mind. The method is simple, although it takes preparation. Before the class demonstration, instructors will need to take a cheap spoon and repeatedly bend it at the neck. Eventually, the neck of the spoon will become so weak that gently rubbing it will make the spoon bend or crack. This demonstration can generate a fruitful discussion on hypothesis generation. One hypothesis is that the instructor has psychic abilities, although students will quickly generate alternative hypotheses. Following this engaging demonstration, instructors may want to provide an overview of Uri Geller. Copious video footage of Geller in action is available online; such as Geller's failure to show any psychic ability on *The Tonight Show*[5].

Uri Geller is just one of many examples of purported psychics that can be a starting point for classroom discussion. Instructors can use videos or websites of celebrity psychics such as Sylvia Browne, John Edwards, or James van Praagh, and allow students to investigate the validity of their claims. Sylvia Browne, who passed away in 2013, made many appearances on such programs as the *Montel Williams Show*, *Larry King Live*, and other talk shows. In 2004, Browne appeared on the Montel Williams show and told the parents of Amanda Berry that their daughter had been murdered. In fact, Berry had been kidnapped in 2003, and escaped in 2013 in a high-profile story in Cleveland, Ohio. Sadly, Amanda's

[2]www.quackwatch.org

[3]http://youtu.be/zdtqLNeK6Ww

[4]www.quantummansite.com

[5]http://youtu.be/lTn0t_7pGZo

mother died in 2006, believing that her daughter had been murdered.

Preeminent skeptic James Randi publicly challenged Sylvia Browne to prove her psychic ability. Randi, who wrote a book exposing Uri Geller (Randi, 1982a), is the founder of the James Randi Educational Foundation, which is dedicated to debunking pseudoscientific claims (Randi, 1982b). Randi, a former magician, offers a one million-dollar prize for anyone who can provide evidence of "paranormal, supernatural or occult power or events" in a scientifically controlled environment. Over the years, hundreds of people have tried, but no one has yet passed the preliminary tests. On an episode of *Larry King Live* in 2001, Browne agreed to take the million-dollar challenge, but refused to be tested after the program aired. As a class exercise, instructors can ask students to act as James Randi (see his appearance on CNN's *Anderson Cooper360* discussing Sylvia Brown[6]), and design the test for Browne. Students should provide the evidence they would need before they would be willing to hand over the million dollars. This exercise helps students become engaged with research methodology, and highlights the type of extraordinary evidence needed to support extraordinary claims.

ALIENS AND GOBLINS

From *The Day the Earth Stool Still* (1951) to *Dark Skies* (2013), aliens have been ubiquitous in popular culture. Alien abductions, invasions, or the mere existence of aliens provides a fascinating source of topics for classroom discussion. One example with which students may not be familiar is the curious case of the Hopkinsville Goblins (Nickell, 2006).

In 1955, 11 witnesses claimed that they were attacked by aliens, whom were approximately four feet tall, and bearing talons or claws. The aliens, or "goblins" as they were originally called, were silver, seemed to float or fly above the ground, and had thin legs. The goblins appeared shortly past 8:00 PM, and terrorized the family until midnight. At this point, some members of the family escaped and sought help from local authorities. Given the details and vivid eyewitness accounts, students may assume the case offers compelling evidence of alien visitation. Instructors should encourage students to consider what additional evidence would be required to accept this extraordinary claim, and to lay out plausible alternative explanations for the events.

The Hopkinsville entities have a decidedly earthly explanation. The "aliens" were in fact, Great Horned Owls, and the eyewitnesses were probably intoxicated during the "alien attack" (Davis and Bloecher, 1978). Students usually find the true story of the events amusing; and this example can lead naturally into a discussion on Area 51, the Greys, or other otherworldly interests (Nickell, 2012; Leman and Cinnirella, 2013).

OTHER PSEUDOSCIENCE CLASSROOM ACTIVITIES

An informative class exercise is to allow students to hunt for examples of pseudoscience on their college or university campus. Upon return from their scavenger hunt, students can describe what they found, and why it could be considered pseudoscientific. Students are often surprised at how easy it is to find an example of pseudoscience on campus. Typically, they find books in the library, posters on campus promoting alternative health or study remedies, or advertisements in the school paper. The exercise drives home the point that students need to be skeptical thinkers, because questionable claims surround them.

Students can also be asked to locate examples of pseudoscience on television, online, or in books and magazines. One resource is *Most Haunted*, a British television program in which a team of investigators, including psychics and skeptics, examine haunted places. The methodology used by the team is far from rigorous, although students find the program entertaining. Instructors can ask students to imagine that they were part of the investigative team on *Most Haunted*, and then describe what would they do differently to determine whether ghosts are real.

The goal of using pseudoscientific examples is to create skeptical, not cynical, thinkers. As skeptical thinkers, students should be urged to remain open-minded. For example, they should not dismiss the existence of ghosts out of hand, but instead ask what evidence would convince them that spirits are among us. Students enjoy the challenge of creating their own ghost hunt, and this activity drives home key points in the discussion of scientific methodology. Although many shows are dedicated to hunting ghosts and monsters, *Most Haunted* is particularly useful, as the resident skeptic, Ciarian O'Keeffe, debunked one of the psychics on the program, Derek Acora. Dr. O'Keeffe suspected that Acora was being fed information prior to their investigations. To test this hypothesis, Dr. O'Keeffe created a story about "Kreed Kafer," and left the information such that Acora had access to it. During the filming, Acora became "possessed" by the ghost of Kreed Kafer. . .which is an anagram of Derek Faker. The footage of the possession can be found on YouTube[7].

Another task to help students understand the differences between science and pseudoscience is to ask the class to cooperate to create their own form of pseudoscience. Students can be quite creative as they try to "top" pseudoscientific ideas like QuantumMAN. One favorite was a project on past-life regression therapy – instead of past life, the students created future-life therapy. Through the magic of quantum mechanics, the supposed future-life therapist could look into the future for diseases, and administer treatment today with homeopathic remedies. Patients would know it was working if they did not suffer from the diseases that the therapist saw in the future. Brilliant!

These examples are only starting points. Although largely outside the scope of this paper, the topic of alternative medicine can also make for fruitful classroom discussion, especially because: (a) many students have had direct experience with it and (b) there is serious question regarding whether any form of alternative medicine works better than placebo (Bausell, 2007). For instance, hundreds of studies have investigated homeopathy, and although a few meta-analyses show effects beyond a placebo (e.g., Kleijnen et al., 1991; Linde et al., 1997; Cucherat et al., 2000), the methodological quality of the research in these meta-analyses is poor. To explore these points, instructors can ask students to conduct a literature review in peer-reviewed journals on homeopathy or related

[6]http://youtu.be/YuPadpaTwKY

[7]http://youtu.be/ZbF_l5nwmGs

topics, and contrast it with what is found in non-peer reviewed sources. Students will find that the evidence from reputable journals indicates that homeopathic remedies do not work (Singh and Ernst, 2008; Shapiro, 2009; Ernst, 2010). A comprehensive list of other questionable alternative remedies, such as acupuncture, energy therapy, and rebirthing, can be found at www.quackwatch.com.

We further encourage instructors to explore resources such as the Penn & Teller program *Bullshit* (although as the name suggests, the language is coarse, and the tone can at times be mean-spirited) and comedian-songwriter Tim Minchin's amusing videos on YouTube on scientific thinking and skepticism (such as his ode to Oberg's Dictum, or the notion that we should keep an open mind but not so open that our "brains fall out," at http://youtu.be/bBUc_kATGgg). Prominent skeptics such as the late Carl Sagan, Michael Shermer, Phil Plaitt, and Richard Wiseman all have many resources available online, and are well worth exploring. By capitalizing on these and other excellent online sources, instructors can persuade students that scientific thinking is not only invaluable as a means of evaluating claims in everyday life, but immensely fun as well.

A WARNING

As a caveat to instructors, research suggests that the use of pseudoscientific examples enhances scientific thinking, but only if framed correctly. The presentation of pseudoscience in a class that typically focuses on science can occasionally confuse students and even lead to "backfire effects" (in which they come to view the unsupported claim as well-supported), as some students may remember the pseudoscientific example, but forget that it is discredited (Lewandowsky et al., 2012). Instructors need to ensure that students understand the examples are pseudoscientific by referring back to the signs of pseudoscience within the discussion of each pseudoscientific example. For additional strategies to avoid student confusion, see Lewandowsky et al.'s (2012) review of the misinformation effect and how to correct for it.

CONCLUDING THOUGHTS

Especially in today's world of 24/7 information and misinformation, students need to be able to evaluate extraordinary claims of many kinds. Fortunately, by directly addressing and then refuting non-scientific claims, science educators can dispel pseudoscience and promote scientific skepticism, while avoiding the unhealthy extremes of either uncritical acceptance or cynicism. In this way, science instructors can help students to become more thoughtful and discerning consumers of evidence, not only in the classroom, but in daily life.

REFERENCES

Bausell, R. B. (2007). Snake oil science: the truth about complementary and alternative medicine. *Medicine* 3, 18.

Beyerstein, B. L. (1999). "Whence cometh the myth that we only use ten percent of our brains?" in *Mind Myths: Exploring Popular Assumptions About the Mind and Brain*, ed. S. Della Sala (Chichester: John Wiley and Sons Ltd), 1–24.

Byrne, R. (2006). *The Secret*. New York, NY: Atria Books.

Cucherat, M., Haugh, M. C., Gooch, M., and Boissel, J. P. (2000). Evidence of clinical efficacy of homeopathy. *Eur. J. Clin. Pharmacol.* 56, 27–33. doi: 10.1007/s002280050716

Davis, I., and Bloecher, T. (1978). *Close Encounter at Kelly and Others of 1955*. Evanston, IL: Center for UFO Studies.

Ernst, E. (2010). Homeopathy: what does the "best" evidence tell us. *Med. J. Aust.* 192, 458–460.

Impey, C., Buxner, S., and Antonellis, J. (2012). Non-scientific beliefs among undergraduate students. *Astronom. Educ. Rev.* 11:0111. doi: 10.3847/AER2012016

Kleijnen, J., Knipschild, P., and ter Riet, G. (1991). Clinical trials of homoeopathy. *Br. Med. J.* 302, 316–323. doi: 10.1136/bmj.302.6772.316

Kowalski, P., and Taylor, A. K. (2009). The effect of refuting misconceptions in the introductory psychology class. *Teach. Psychol.* 36, 153–159. doi: 10.1080/00986280902959986

Leman, P. J., and Cinnirella, M. (2013). Beliefs in conspiracy theories and the need for cognitive closure. *Front. Psychol.* 4:378. doi: 10.3389/fpsyg.2013.00378

Lewandowsky, S., Ecker, U. K., Seifert, C. M., Schwarz, N., and Cook, J. (2012). Misinformation and its correction continued influence and successful debiasing. *Psychol. Sci. Public Interest* 13, 106–131. doi: 10.1177/1529100612451018

Lilienfeld, S. O., Ammirati, R., and David, M. (2012). Distinguishing science from pseudoscience in school psychology: science and scientific thinking as safeguards against human error. *J. School Psychol.* 50, 7–36. doi: 10.1016/j.jsp.2011.09.006

Lilienfeld, S. O., Lohr, J. M., and Morier, D. (2001). The teaching of courses in the science and pseudoscience of psychology: useful resources. *Teach. Psychol.* 28, 182–191. doi: 10.1207/S15328023TOP2803_03

Lilienfeld, S. O., Lynn, S. J., and Lohr, J. M. (eds). (2004). *Science and Pseudoscience in Clinical Psychology*. New York, NY: Guilford.

Lilienfeld, S. O., Lynn, S. J., Ruscio, J., and Beyerstein, B. L. (2010). *Fifty Great Myths of Popular Psychology*. Chichester: Wiley-Blackwell.

Linde, K., Clausius, N., Ramirez, G., Melchart, D., Eitel, F., Hedges, L. V., et al. (1997). Are the clinical effects of homoeopathy placebo effects? A meta-analysis of placebo-controlled trials. *Lancet* 350, 834–843. doi: 10.1016/S0140-6736(97)02293-9

Losh, S. C., and Nzekwe, B. (2011). The influence of education major: how diverse preservice teachers view pseudoscience topics. *J. Sci. Educ. Technol.* 20, 579–591. doi: 10.1007/s10956-011-9297-0

Manza, L., Hilperts, K., Hindley, L., Marco, C., Santana, A., and Hawk, M. V. (2010). Exposure to science is not enough: the influence of classroom experiences on belief in paranormal phenomena. *Teach. Psychol.* 37, 165–171. doi: 10.1080/00986283.2010.488554

Nickell, J. (2006). Siege of the "little green men": the 1955 Kelly, Kentucky, incident. *Skeptical Inquirer* 30.6. Available at http://www.csicop.org/si/show/siege_of_little_green_men

Nickell, J. (2012). States of mind: some perceived ET encounters. *Skeptical Inquirer* 36.6. Available at http://www.csicop.org/si/show/states_of_mind_some_perceived_et_encounters

Novella, S. (2013). Pseudoscience in our universities. *Skeptical Inquirer* 36.3. Available at http://www.csicop.org/SI/show/pseudoscience_in_our_universities

Pigliucci, M., and Boudry, M. (2013). *Philosophy of Pseudoscience: Reconsidering the Demarcation Problem*. Chicago, IL: The University of Chicago Press. doi: 10.7208/chicago/9780226051826.001.0001

Randi, J. (1982a). *The Truth about Uri Geller*. Buffalo, NY: Prometheus Books.

Randi, J. (1982b). *Flim-flam!: Psychics, ESP, Unicorns, and Other Delusions*. Buffalo, NY: Prometheus Books.

Sagan, C. (1995). *Demon-Haunted World: Science as a Candle in the Dark*. New York, NY: Random House.

Shapiro, R. (2009). *Suckers: how Alternative Medicine Makes Fools of Us All*. New York, NY: Random House.

Shtulman, A., and Valcarcel, J. (2012). Scientific knowledge suppresses but does not supplant earlier intuitions. *Cognition* 124, 209–215. doi: 10.1016/j.cognition.2012.04.005

Singh, S., and Ernst, E. (2008). *Trick or Treatment: The Undeniable Facts about Alternative Medicine*. New York, NY: WW Norton & Company.

Stanovich, K. E. (2010). *Decision Making and Rationality in the Modern World*. Oxford: Oxford University Press.

Stanovich, K. E. (2012). *How to Think Straight about Psychology*, 10th Edn. Boston, MA: Allyn and Bacon.

Truzzi, M. (1978). On the extraordinary: an attempt at clarification. *Zetetic Scholar* 1, 11–19.

Winer, G. A., Cottrell, J. E., Gregg, V., Fournier, J. S., and Bica, L. A. (2002). Fundamentally misunderstanding visual perception: adults' belief in visual emissions. *Am. Psychol.* 57, 417. doi: 10.1037/0003-066X.57.6-7.417

Zollman, C., and Vickers, A. (1999). ABC of complementary medicine: what is complementary medicine? *Br. Med. J.* 319, 693–696. doi: 10.1136/bmj.319.7211.693

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Relation between contemplative exercises and an enriched psychology students' experience in a neuroscience course

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This article examines the relation of contemplative exercises with enhancement of students' experience during neuroscience studies. Short contemplative exercises inspired by the Buddhist tradition of self-inquiry were introduced in an undergraduate neuroscience course for psychology students. At the start of the class, all students were asked to participate in short "personal brain investigations" relevant to the topic presented. These investigations were aimed at bringing stable awareness to a specific perceptual, emotional, attentional, or cognitive process and observing it in a non-judgmental, non-personal way. In addition, students could choose to participate, for bonus credit, in a longer exercise designed to expand upon the weekly class activity. In the exercise, students continued their "personal brain investigations" for 10 min a day, 4 days a week. They wrote "lab reports" on their daily observations, obtained feedback from the teacher, and at the end of the year reviewed their reports and reflected upon their experiences during the semester. Out of 265 students, 102 students completed the bonus track and their final reflections were analyzed using qualitative methodology. In addition, 91 of the students answered a survey at the end of the course, 43 students participated in a quiz 1 year after course graduation, and the final grades of all students were collected and analyzed. Overall, students reported satisfaction from the exercises and felt they contributed to their learning experience. In the 1-year follow-up, the bonus-track students were significantly more likely than their peers to remember class material. The qualitative analysis of bonus-track students' reports revealed that the bonus-track process elicited positive feelings, helped students connect with class material and provided them with personal insights. In addition, students acquired contemplative skills, such as increased awareness and attention, non-judgmental attitudes, and better stress-management abilities. We provide examples of "personal brain investigations" and discuss limitations of introducing a contemplative approach.

Keywords: contemplative pedagogy, contemplative neuroscience, pedagogical psychology, pedagogical neuroscience

INTRODUCTION

The wealth of discoveries that neuroscientists have been making over the last three decades is driving the imagination of students from a wide range of academic fields, including the humanities and social sciences (Wiertelak and Ramirez, 2008). The appeal of neuroscience is that it offers new perspectives on human behavior and experience, making it an exciting interdisciplinary field. However, for many students in the humanities and social sciences, this new perspective is often so different from the perspectives they are used to, that the same things that had attracted them to learn neuroscience are the things that also elicit resistance (Harrington, 2013). For example, the reductionist and mechanistic neuroscience explanations often make it difficult for students to relate brain functions to their daily experiences and beliefs (Harrington, 2013). Others, especially students majoring in therapy-related fields such as psychology or social work, fail to see the relevance of significant parts of the curriculum (e.g., chapters discussing sensory and motor processes or attention) to the understanding of complex mental phenomena related to clinical work such as emotions and mood. The myriad of advances in pedagogical techniques, enhanced by technological advancements (e.g., Av-Ron et al., 2006; Brann and Sloop, 2006; Schneider et al., 2013; Schettino, 2014), have mostly suggested means to improve the teaching of theoretical neuroscience material. However, the need to arise students' curiosity and motivation and help students connect the course content to their lives and to their professional settings remains a challenge for many neuroeducators (Waldvogel, 2006; Harrington, 2013; Pollack and Korol, 2013).

Neuroeducators are not alone in this challenge. The need to complement the classical learning processes with an experiential dimension is a concern of many educators, and has led to the development of experiential learning theories (Kolb, 1984). These theories emphasize the processes of observation and reflection and the importance of *here-and-now* concrete

experiences as a means to test and validate abstract concepts (Kolb, 1984). Approaches that have been developed within the experiential pedagogical framework augment immediate engagement with learned material by encouraging students to reflect upon a problem related to class material, and then enter a process of exploration and experimentation with the problem (Stewart and Stavrianeas, 2008). Indeed, extensive pedagogical experience has shown that students are more receptive to learning a topic of interest if they are allowed hands-on access to it (Allard and Barman, 1994; Colburn and Clough, 1997; Blank, 2000; Lawson, 2000; Stewart and Stavrianeas, 2008).

When coming to apply similar experiential approaches to the teaching of neuroscience, it is natural to design processes of reflection and exploration around physical objects (e.g., a slice of a rodent's brain) or using external knowledge databases (such as the Internet) to assist the exploration process of a topic. For example, Stewart and Stavrianeas (2008), developed a laboratory activity exploring issues of memory in order to enrich a neuroscience undergraduate class geared toward non-science students. In the laboratory activity, students imagined being notified that their grandmother has been diagnosed with Alzheimer's and used various databases to explore the memory deficits associated with the disease and characterize its symptoms.

Here we suggest that contemplative methods and first-person tools can expand such an experiential pedagogical approach, by enabling hands-on exploration of internal mental processes as a means to engage students in neuroscience courses. Contemplative methods cultivate inner awareness through rigorous first-person investigations. When introduced in an educational setting, these methods have been shown to encourage experiential and affective learning (Miller, 1994; Hart, 2004; Zajonc, 2006b; Brady, 2007; Shapiro et al., 2011). Indeed, recently there has been a growing interest in integrating contemplative methods into higher education (Bush, 2011; Barbezat and Bush, 2013; Zajonc, 2013) to accompany traditional ways of learning (e.g., critical or analytical reasoning). Contemplative pedagogy can range from silence at the start of the class to exercises that cultivate general mental capacities (e.g., concentration) to support the learning process. More recently, innovative contemplative practices relating to course content have been developed and introduced into courses ranging from theater to economics, philosophy and cosmology (Zajonc, 2006a). However, as far as we know, the use of contemplative tools to support neuroscience teaching has not been yet described.

In many ways, neuroscience courses are ideal for introducing contemplative methods. This is mainly due to the fact that in recent years Buddhist psychology and practices, as well as Buddhist contemplative methods of inquiry, have been gaining popularity in the fields of neuroscience and psychology (Varela et al., 1992; Lutz and Thompson, 2003; Lutz et al., 2007; Lutz, 2010; Desbordes and Negi, 2013). Mindfulness meditation, one of the central techniques used by Buddhists in their observations and experimentations on the human mind (Varela et al., 1992; Lutz et al., 2007; Dorjee, 2010; Lutz, 2010; Grabovac et al., 2011), has especially attracted the attention of the scientific community. Mindfulness can be defined as a skill set in which three attentional skills work together (Young, 2013). The first is the skill of concentration, which enables the direction and stabilization of attention toward an object of inquiry. The second is the skill of perceptual clarity toward anything that arises at the present moment. The third is the skill of holding an attitude of equanimity and "letting go" of judgments about the object of inquiry. Jon Kabat Zinn's famous sentence, "where ever you go, there you are," (Kabat-Zinn, 1994) captures the essence of the experience of being mindful—the ability to dispassionately observe the experience of the present moment with nonjudgmental openness. According to traditional Buddhist texts the mindful awareness skill set can be directed toward the investigation of many levels of the human experience, including processes related to physical senses, emotions, thoughts, and various states of consciousness (Ekman et al., 2005; Raffone and Srinivasan, 2010; Grabovac et al., 2011).

On one hand, Buddhist methods of inquiry are similar to Western scientific methods in that they take an objective nonjudgmental, non-personal stance toward their objects of inquiry. On the other hand, these methods of inquiry are directed toward the subjective self and in what underlies its subjectivity. Thus, they can bridge the gap between the neuroscientific viewpoint of the human being and the psychological one. Indeed, a new field called "contemplative neuroscience" has emerged in which neuroscientists not only study the neural correlates of various contemplative methods but attempt to combine methods of contemplation with scientific inquiry (Varela et al., 1992; Gallagher and Varela, 2003; Lutz et al., 2007; Lutz, 2010; Desbordes and Negi, 2013). Researchers in this field believe that such contemplative methods can advance scientific theories and models of consciousness, emotion and cognitive processing (Overgaard et al., 2008). Francisco Varela, one of the leading figures in this field, has claimed that contemplative tools are essential because "without embracing the relevance and importance of everyday, lived human experience, the power and sophistication of contemporary cognitive science could generate a divided scientific culture in which our scientific conceptions of life and mind on the one hand, and our everyday, lived self-understanding on the other, become irreconcilable" (Varela et al., 1992).

Importantly, the use of contemplative first-person methods as a quantitative tool in cognitive sciences is still a matter of debate (Overgaard et al., 2008). Experimental psychology has long abandoned introspective or phenomenological methods, and although contemplative methods offer a first-person approach that is based on higher levels of attentional stability, the subjective nature of first-person observations and the fact they cannot be intersubjectively verified still poses a serious hurdle (Overgaard et al., 2008). Though several attempts have been made to use first-person data to guide neuroscientific understanding (e.g., Lutz et al., 2002; Petitmengin et al., 2006; Dor-Ziderman et al., 2013), there are presently no generally agreed upon methods for first-person data collection in experimental psychology and neuroscience studies.

Despite the fact that it is still not clear how the contemplative neuroscience tools should be used in the scientific quest to understand the relation between brain and mind, we suggest here that such first-person tools, when used cautiously, can be effective pedagogical tools. Specifically, the skills developed in mindfulness awareness practice, such as enhanced awareness, attentional stability, and a non-judgmental stance toward experience, can be offered to students in a neuroscience course as a method

to examine their experience in a systematic way. This kind of experiential learning can in turn arouse students' curiosity and motivation to understand the relation between mind and brain and relate theoretical class material to their daily life, enhancing the saliency of course information and leading to greater course learning and satisfaction (Waldvogel, 2006; Harrington, 2013; Pollack and Korol, 2013).

This paper contains a detailed description of how the mindfulness-awareness skill set was introduced in a semester-long advanced neuroscience class, which was taught to undergraduate students majoring in psychology in one of the universities in Israel. During the course, this skill set was developed and used to create an "experimental contemplative lab" in which students used first-person investigation tools (termed here "personal brain investigations") to enrich their understanding of the topics learned theoretically in neuroscience courses. This "experimental contemplative lab" provided the teacher the ability to engage students in material that was presented in class (e.g., attention systems or emotion processes in the brain) in an experiential way. Namely, students contemplated upon a specific mental process (by observing its unfolding in themselves), reflected upon the experience, experimented with different aspects of the experience (for example, they compared differences in physiological responses between a happy memory and a disgusting one) and described their observations (either orally in class or via written reports outside the classroom).

In addition to triggering immediate engagement in class material, there were additional goals to the use of the "personal brain investigations": first, to help students bridge the gap between a theoretical understanding of brain function and their own personal psychological experiences; second, to acquaint the students with the advantages and shortcomings of a contemplative method of inquiry that is not often used in contemporary pedagogy; and third, to provide students with the opportunity to experience the ability to use mental training as a means of enhancing brain-based processes they were introduced to in class, such as attention and emotion-regulation skills (Davidson et al., 2012).

Although students' reactions seemed very enthusiastic toward this pedagogical approach, we submitted it to an empirical evaluation. Based on the pedagogical framework and the goals stated above, we set out to investigate whether "personal brain investigations" would be associated with student satisfaction and enhanced course learning. Specifically, we investigated whether these exercises were associated with better final grades, with the ability of students to relate class material to their daily life and with better long-term retention of class information. We also examined whether "personal brain investigations" would relate to students' ability to appreciate the possible contributions of contemplative methods.

In order to test our research questions we undertook a mixed-measures approach using both quantitative and qualitative methods. In the quantitative analysis, the grades of all students were obtained and compared between those who participated in the bonus track and those that didn't; a short survey was given at the end of the semester to assess students' satisfaction from the exercises, the exercises' contribution to students' learning and students' attitude toward a contemplative approach; Finally, a quiz was distributed 1 year after graduation from the course to assess the effect of the "personal brain investigations" on memory of class material. The qualitative analysis was introduced in order to gain a deeper understanding of how the contemplative exercises contributed to the students. The qualitative analysis method was based on thematic analysis of students' self-reports at the end of the course.

In this paper, we describe the "experimental contemplative lab" that was created to support neuroscience teaching. We provide examples of "personal brain investigations," along with an explication of how they related to different class topics. We then review excerpts from students' "findings" following their investigations, and report the results of our quantitative and qualitative evaluations of the process the students underwent. Finally, we discuss the benefits of using contemplative techniques in a neuroscience course and consider the conditions for this approach to be fruitful.

MATERIALS AND METHODS

PARTICIPANTS

The participants in this study were students that enrolled in an undergraduate psychology course entitled "Brain, Cognition, and Emotion," an advanced obligatory neuroscience course at the Interdisciplinary Center (IDC), Herzliya, Israel, in the winter semester of either 2011 or 2012 ($N = 124$ in 2011, 89 females, age range 20–36, mean age 23.5; $N = 143$ in 2012, 98 females, age range 19–37, mean age 23.2).

PROCEDURE

Overview

Contemplative exercises were introduced in the above-mentioned 13-week course, which was taught by the first author who is a neuroscientist as well as a contemplative practitioner with a regular weekly practice and 15 years of experience in various mindfulness practices, including Buddhist Vipassana meditation, Hatha yoga practice and mindfulness-based stress reduction (MBSR, Kabat-Zinn, 2013). The exercises were in the form of "personal brain investigations" that were defined as specific investigations of mental processes, aimed at obtaining a richer understanding of these processes and their relations to other mental and brain processes. The "personal brain investigations" were conducted in two formats. The first consisted of short (10-min) weekly in-class investigations, which were done at the start of each class according to the teacher's instructions. The second consisted of longer investigations that students could choose to do for extra credit as part of a bonus track (4 days a week, 10 min a day). In these longer investigations, students summarized their daily observations, obtained bi-weekly feedback from the teacher, and wrote a final assignment, which included a summary and reflection of the entire investigation process. The evaluation of these contemplative exercises is based upon an anonymous survey that was given at the end of each semester, a short quiz that was distributed to the 2012 class a year after they completed the class, and a qualitative analysis that was performed on the summaries the bonus-track students wrote at the end of the semester.

Presentation of "personal brain investigations" to students

"Personal brain investigations" were defined to the students as specific investigations of their mental processes, aimed at obtaining a richer understanding of these processes and their relations to other mental and brain processes. Students were invited to take a "third-person" scientific stance and assume an attitude of equanimity and non-judgment toward the objects of investigation (mental and brain processes). It was stressed that the purpose of the investigations was not one of personal, psychological self-inquiry but rather an opportunity to have a unique view of the human experience. Students were invited to imagine that they were entering a laboratory, putting on a white lab-coat and peering into a special microscope; the fact that it was their own brain they were viewing was due to the "mere constraints of the situation."

Students were told that "personal brain investigations" were a form of contemplative exercise. They were also given a brief account of the developing field of contemplative neuroscience and how various contemplative techniques have been gaining interest among neuroscientists, who are interested both in their neural effects and the possibility to use them as scientific methods. Importantly, the ongoing debate among cognitive scientists regarding the use of first-person methods was discussed. In addition to introducing arguments in favor of the contemplative approach and examples of attempts to use it as a scientific methodology (Jack and Roepstorff, 2002; Lutz et al., 2002; Petitmengin et al., 2006; Desbordes and Negi, 2013), the shortcomings of, and objections to, this approach were also discussed (Jack and Roepstorff, 2002; Overgaard et al., 2008). It was emphasized that although much insight can be gained from first-person investigations, their use as a scientific tool is still controversial.

Weekly in-class and bonus credit exercises

The "personal brain investigations" were conducted in two settings:

A. *In-class investigations*: All students who attended the class were invited to participate in a "personal brain investigation" relevant to the day's subject matter. These "personal brain investigations," which lasted 10-min and took place at the start of each class, were aimed at bringing awareness to specific functions (e.g., related to perceptual, emotional, attentional, thought, or interpersonal processes) and observing them in non-judgmental, non-personal ways. Students were not forced to participate, but were asked not to engage in any activity that might disturb other students (e.g., typing on a computer).
B. *Bonus-track investigations:* Students could choose to participate, for bonus credit, in a longer exercise designed to expand upon the weekly in-class investigations. In this bonus track, students (hereafter called "bonus-track students") were asked to continue their investigations for 10 min a day, 4 days a week, and write a weekly "lab report" on their daily observations. In each week, the exercises resembled those given in class but the prompts were often broader, containing suggestions for non-formal inquiry in daily life (e.g., "notice the things that work like magnets on your attention while you are walking on campus"). The bonus-track students' reports were reviewed by the teacher every 2 weeks via an online system. In addition to the weekly lab reports, students were given an assignment at the end of the semester to summarize their observations and insights, and reflect upon their experiences during the semester.

The only prerequisite to gain credit in the bonus track was full participation and completion of all the requirements. Students could drop out at any point without penalty. However, they could not stop the longer exercises and then return to completing them. Students were explicitly told that there were no correct or incorrect answers, as anything that might arise (including difficulties and resistance to the exercise itself) would be legitimate, so long as the investigation process was occurring and awareness was brought to it. Of the students enrolled in the courses, 56% ($N = 70$) of students from the 2011-class joined the bonus track and 59% ($N = 84$) did so in 2012. Seventy percent of the joining students ($N = 49$, 41 females) completed the bonus track in 2011 and 63% ($N = 53$, 46 females) did so in 2012.

Ongoing review of bonus-track students' lab reports

Once every 2 weeks the teacher provided students in the bonus track with feedback on their work. The teacher endeavored to take a non-judgmental stance toward the students and encouraged each to maintain a non-subjective, non-judgmental attitude. On occasion, the teacher suggested further inquiry regarding interesting observations or told them to keep up with the good work. Bonus-track students were requested to write short, technical reports beginning with sentences like "I noticed that X happens when Y happens." They were also asked to write in a non-personal tone (e.g., "I noticed thoughts can stimulate feeling X" rather than "I have thoughts that make me feel X").

Examples of "personal brain investigations"

Both in class and at home (for the bonus track), the first few investigations and the beginning of all subsequent investigations were dedicated to the development of concentration as well as equanimity skills (i.e., developing personal tools for investigation). Students were asked to bring their attention to their breathing process and to count the number of breaths they were able to be fully aware of before becoming distracted. When a person had realized his/her attention had wandered and was no longer focused on the breath, s/he should re-start the counting and try to maintain awareness for a greater number of breaths. They were encouraged to see this as a "polishing the microscope lens" exercise and be non-judgmental toward their success or failure. Subsequent investigations always began with a few minutes of the "polishing the microscope lens" exercise, wherein students attempted to reach the count of 10 full breaths without becoming distracted. Interestingly, even the "polishing the microscope lens" exercise provided many opportunities for investigation and discovery (for example, examining what made it so difficult to be completely aware of 10 full breaths).

Several examples of "personal brain investigation" are listed below (see Supplementary Section for additional examples).

Example 1: Investigating magnets of attention. This investigation was conducted at the beginning of a class about the ventral and dorsal attention networks in the brain, which are dedicated to the detection of novel stimuli and the focusing of attention, respectively (Corbetta and Shulman, 2002; Purves, 2008). Students were invited to conduct the "polishing the microscope lens" exercise for 10 min while noticing the internal experiences, as well as the external objects, that diverted their attention away from a focus on the breath. Students' findings were shared in class and later discussed in the context of the ventral and dorsal attention networks.

In the same week, students in the bonus track expanded this investigation at home in four 10-min daily exercises. They were encouraged to investigate which types of stimuli (e.g., human voices vs. mechanical noise) captured their attention more easily, and how different emotional and arousal states influenced their ability to focus their attention on the breath. They were encouraged to continue this investigation in different life-settings (e.g., walking in the park, sitting in the cafeteria).

Example 2: Investigating the relationships among emotions, sensations, and thoughts. This investigation was conducted at the beginning of a class discussing theories of emotions (e.g., the James-Lang, the Cannon-Bard, the Schachter-Singer and the Cacioppo theories; Freberg, 2009) and the attempts of these theories to address the relationships among emotions, physiological processes, and cognitive evaluations. Following a short (3-min) "polishing the microscope lens" exercise, students were asked to direct their attention toward their emotional feelings and notice the bodily sensations that accompanied them. They were then asked to remember a pleasant memory and to notice both the emotional feeling and the bodily sensations that accompanied it. The same instruction was repeated for an unpleasant memory. They were instructed to be as precise as possible, noticing where exactly the sensations arose, as well as their temporal sequence, intensity and valence. This whole procedure lasted about 10 min following which students shared their observations in class.

In the same week, the bonus-track students continued this investigation at home while receiving additional instructions. The group was asked to notice the order in which emotions, thoughts, or bodily sensations arose—and how the order changed on a daily basis based on mood or external events. As a "non-formal," optional inquiry they were asked to choose one transition a day (e.g., entering/exiting the college, entering/exiting their house, entering/exiting their car) and to stop for a few seconds to notice the state of their bodily feelings and how it was affecting their mood and behavior.

Example 3: Investigating emotional valence. This investigation was conducted in the beginning of a class that dealt with the valence hypothesis in relation to brain lateralization (Purves, 2008; Miller et al., 2012). Following a short "polishing the lens" process, students were asked to direct their attention toward their emotional feelings and notice whether the bodily expression was "pleasant," "unpleasant," or "neutral." After 10 min, students shared their observations with the class.

In the bonus track that week, students were asked to deepen their investigation, and notice changes in the valence of sensations and emotions during each of the four daily inquiries, as well as whether sensations and emotions fluctuated on a daily basis based on mood or external events.

Example 4: Investigating the relation between intrinsic and extrinsic processes. This investigation was conducted in a class that dealt with the brain's intrinsic network (also known as the "default state" network; Raichle and Snyder, 2007; Purves, 2008, p. 321). Students were taught that the default network tends to deactivate when an extrinsic network (also known as the "task positive" network) is activated (Raichle and Snyder, 2007), and that it has been related to autobiographical memory and to stimulus-independent thought processes and mind-wandering (Mason et al., 2007). In class, therefore, students were asked to notice and compare the appearance of internally evoked thoughts and emotions in two different situations—when focusing on their breath (a relatively passive task) and when counting backwards from 100 in steps of 7 (a relatively difficult task necessitating additional attention resources).

That week, the bonus-track group was asked to deepen this investigation and observe the rate of occurrence of internal processes (e.g., thoughts and emotions) in a variety of tasks that differed in the type and amount of effort required. They were asked to notice if, and in what way, the appearance of internal processes affected the activity they were engaged in. Tasks included focusing on the breath, counting backward from 100 in steps of 7 (as we did in class), focusing attention on one's feet (and trying to notice the subtle sensations that arose), and focusing on the subtle details of a movement task (e.g., bringing the hands back and forth above the head to touch each other). As a non-formal, optional inquiry students in the bonus track were asked to pay attention to the tasks that completely absorbed them, and to those that allowed some internal processing.

EVALUATIONS OF THE "PERSONAL BRAIN INVESTIGATIONS"

Ethical approval

Following approval by the local ethics committee, informed consent was obtained from students for using their bonus-track summaries, survey answers and quiz results for the evaluation of the pedagogical method they had experienced in class.

Descriptive statistics of students

When analyzing the grades obtained by students in the basic neuroscience course that was taught in the previous year (entitled "The physiological basis of behavior") by the same teacher, we found that students that participated in the bonus track program obtained a significantly higher grade in the course ($M = 88.01$, $SD = 5.79$) as compared to students that did not participate in the program ($M = 85.85$, $SD = 7.57$). In other words, students that participated in the bonus program had *a priori* significantly higher grades as compared to students that did not enroll in the program [$t_{(225)} = 2.32$, $p < 0.05$, Cohen's $d = 0.32$]. In spite of this fact, the bonus-track group was not composed only of strong students. When splitting the students based on their median grade from the previous year into two groups, 36.8% of students who

Table 1 | Number of students used in various measures.

	Overall	Joined bonus track	Completed bonus track	Filled survey	Filled quiz	Grade	Qualitative evaluations
2011	124	70	49	42		103	49
2012	143	84	63	49	43	124	53

The table describes for each year, the number of overall number of students that participated in the class, the number of students that joined the bonus track, the number of students that completed the bonus track, the number of students that filled the survey, the number of students that participated in the quiz, the number of students for which grades were obtained, the number of students that their final reports were submitted to qualitative analysis.

enrolled in the bonus track program were below the median, while 46.1% of students were above the median [the difference in percentages being non-significant ($\chi^2_{(1)} = 1.99$, $p = 0.16$)]. **Table 1** describes the number of students participating in the various measures described here and below.

Quantitative evaluations

Survey. At the end of the semester a research assistant distributed an anonymous survey to all students who were present in class ($N = 42$ completed the survey in 2011 and $N = 49$ in 2012; classes were not obligatory, but by the end of the semester approximately ∼70 students were attending each class). The survey related to both in-class and bonus track brain investigations. Students were asked to report the number of brain investigations they participated in during class and whether they participated in the bonus track. Then, for each category (weekly investigations and bonus track), students were asked to rate on a 5-point Likert scale their satisfaction with the personal brain investigations, how much they felt they had learned from them, and whether they would use such a contemplative approach in the future. Since the bonus-track group invested much effort in the personal brain investigations we also asked how important they believe it was to combine these investigations in the training process of psychology students. For assessing the overall impact of each rating, the averages of each scale were compared to the midpoint of the scale ($M = 3$) using one-sample t-tests.

Quiz at 1-year follow-up. In addition to assessing student satisfaction, we were interested in examining whether our contemplative approach contributed to the long-term retention of class material. With this aim, we distributed a quiz at the beginning of another undergraduate psychology course, "Abnormal Psychology," which is obligatory and taken by all students the year after the "Brain, Cognition, and Emotion" course. The aim of this quiz was to assess how much they remembered from the previous year's "Brain, Cognition, and Emotion" class. This follow-up quiz was given only to students from the 2012 year, and only to those who were present in class on that day. The quiz contained 10 multiple-choice questions taken from previous exams as well as a short questionnaire assessing whether students participated in the brain investigations in class and in the bonus track. We also requested their self-assessment of the amount of classes they attended (0–25, 26–50, 51–75, 76–100%), their level of participation in class in general (below average, average, above average), and their level of concentration in class (low, medium, high). In addition, we asked them to indicate the range of their final course grade (0–60, 61–70, 71–80, 81–90, 91–100). Overall, 43 students completed the quiz; all responses were anonymous. We first compared students who indicated that they participated in the bonus track ($N = 22$) to those who indicated that they did not participate in the program ($N = 19$). Two students who indicated that they participated in a partial manner in the bonus track were not included in the bonus track analyses. As the variances of the groups did not significantly differ [$F_{(1,\ 39)} = 0.225$, $p = 0.638$], the groups were compared using a t-test for independent samples assuming homogeneity of variances. We then compared students who reported participating at least partially in the in-class investigations but not in the bonus track ($N = 9$) to those who reported that they did not participate at all in any investigation ($N = 10$). In this case, too, the variances of the groups did not significantly differ [$F_{(1,\ 17)} = 0.002$, $p = 0.970$], and the groups were compared using a t-test for independent samples assuming homogeneity of variances.

Qualitative evaluations

In the last week of the semester, the bonus-track students were given a "final project" in which they were asked to review all of their findings throughout the semester and summarize the 10 most interesting insights from the process. In addition, they were asked to reflect upon the process in general and to describe their experiences. General guidelines were provided for this feedback: "Please reflect upon your experience, e.g., was it interesting, enjoyable, boring, did you do it because it was obligatory, what would you change, what was most significant, what was least interesting. Please provide additional comments and suggestions that would help us improve in the future." Importantly, students knew that if they completed all the lab reports they would automatically receive full bonus credit, as there were no correct answers.

The reflections and summaries from the 2011 and 2012 bonus-track students were merged together (total $N = 102$). They were analyzed through a thematic analysis grounded in a social constructionist framework (Denzin and Lincoln, 1994), which Braun and Clarke (2006) described as a beneficial method for identifying, analyzing, and reporting patterns (themes) within data. To analyze the summaries, three coders (the first author, who was also the teacher; the second author, who was not related to the development or dissemination of the program; and a psychology student with previous experience in qualitative coding, that was naïve to the aims of the manuscript and was paid for her efforts) first independently read 10 out of the 102 summaries at least twice each, to become familiar with the content and to isolate sentences in an attempt to name and classify central themes. Each sentence could be coded for more than one theme or subcomponent. The three coders then shared their impressions of the themes that arose. In order to reduce bias, a significant effort was made to avoid trying to convince the other coders that a given theme was correct; instead, there was an emphasis on grouping

together, in broader categories, themes that seemed to relate to the same phenomena.

We sought to identify general categories or recurring patterns that could depict a well-fitting, data-driven "story" of participants' experiences. General categories included contribution to the learning process, contribution to personal development, technical aspects of the process, and so forth. We then compared these different general categories to identify possible similarities, thereby enabling the construction of six core themes that each blended several general categories. After the categories were formed, two of the coders analyzed 20 more summaries; additional sub-categories were added and the three coders discussed disparities. Ten more summaries were rated again by two of the coders reaching an average item concordance Kappa between the raters of 0.91. Subsequently, the rater that was not one of the authors coded all remaining summaries, and these classifications served as the data for subsequent analysis. We made extensive use of *in vivo* codes (Strauss, 1987), drawn from the participants' own accounts in ways that attempted to summarize participants' own meanings in their own words.

RESULTS

EXAMPLES OF STUDENTS' OBSERVATIONS AND FINDINGS

Examples of the weekly reports and end-of-semester insights by bonus-track students appear in **Table 2**.

QUANTITATIVE ASSESSMENT

Grades

Students that participated in the bonus track program ($M = 84.46$, $SD = 9.23$) obtained a significantly higher grade in the course [$t_{(228)} = 2.01$, $p < 0.05$, Cohen's $d = 0.28$] as compared to students that did not participate in the program ($M = 81.17$, $SD = 13.91$). However, when taking the grades they obtained in the previous year (see "Descriptive statistics of students" section above) as covariate the difference between the groups, in terms of the final grade in the advanced neuroscience course, became non-significant [$F_{(1,\ 224)} = 0.45$, $p = 0.501$, partial Eta squared $= 0.002$].

Survey

Of the students who answered the survey ($N = 90$), 71% ($N = 64$) participated in the bonus-track. Of the remaining students (who did not participate in the bonus-track), only 11 students reported having participated in most or all brain investigations.

Table 3 displays the average bonus-track student ratings for the in-class weekly investigation—for how much satisfaction they gained from the weekly investigations and how much they learned from them, and how much they would use contemplative tools in the future. One-sample t-tests assessing the average ratings of the three scales yielded significant results (all p's < 0.001) when compared to the midpoint of the scales ($M = 3$), indicating significant levels of satisfaction, learning, and intention to use contemplation tools in the future. Despite the low n, we performed a similar analysis for the 11 students who did not participate in the bonus-track but reported participating in most or all investigations. Although average scores for satisfaction ($M = 3.45$) and future use of contemplative tools ($M = 3.29$) was greater than the midpoint, they were not significantly different ($p > 0.27$).

Table 4 displays the average ratings of the bonus-track students for the bonus-track investigations—for how much satisfaction they gained from the bonus track investigations, how much they learned from them, how much they would use contemplative tools in the future and how important it was to use "personal brain investigations" in the training process of psychology students. The average ratings were again compared to the midpoint of the scale ($M = 3$) using one-sample t-tests. The four analyses yielded significant results (all p's < 0.001).

Quiz

Out of the students who participated in the quiz, 91% of those who reported they had participated in the bonus track also reported to have participated, at least partially, in the in-class investigations. Bonus-track students were not different from students who did not participate in the bonus-track in their reported final grade range [$t_{(39)} = 0.49$, $p = 0.63$], reported class attendance [$t_{(39)} = 0.764$, $p = 0.45$], reported level of participation in class [$t_{(39)} = 0.985$, $p = 0.32$] and the reported level of concentration [$t_{(39)} = 0.71$, $p = 0.48$]. When comparing the results on the quiz, bonus-track students ($M = 5.82$, $SD = 1.37$) answered significantly more correct answers as compared to students who did not participate in the program ($M = 4.68$, $SD = 1.25$) [$t_{(39)} = 2.76$, $p = 0.009$, Cohen's $d = 0.87$, partial Eta squared $= 0.163$]. These results in the quiz remained significant even after controlling for the difference between the groups in their final advanced course grades [$F_{(1,\ 37)} = 8.35$, $p = 0.006$, partial Eta squared $= 0.184$], and also after controlling for their final advanced course grades, the percentage of classes attended, participation during class and concentration [$F_{(1,\ 34)} = 6.13$, $p = 0.018$, partial Eta squared $= 0.153$], as demonstrated by analyses of covariance (ANCOVA). Despite the small n's we also compared quiz results for students who did not participate in the bonus-track but did participate, at least partially, in the in-class investigations ($M = 4.89$, $SD = 1.27$), with those that did neither ($M = 4.50$, $SD = 1.27$). No difference in correct answers was found between the groups [$t_{(17)} = 0.67$, $p = 0.51$].

QUALITATIVE ASSESSMENT

When performing a thematic analysis on the summaries and reflections that the bonus-track students wrote at the end of the semester, we revealed several core themes. These included: emotions, contribution and insights, dynamics, sense of duty, developing a tool, and reference to technical aspects. Each of these core themes and their sub-categories are presented below (see **Figure 1**). Due to lack of space only a few quotes from students' summaries are provided for each sub-category. A full list of examples is given in Table S2 in the Supplementary Section.

Emotions

The first core theme that appeared in most of the students' comments (80%), related to emotions elicited by the process.

Enjoyment/positive emotion. A majority of students (55%) mentioned either feeling enjoyment or some other positive/enriching

Table 2 | Examples of student observations in the personal brain investigations.

Concentration training—"Polishing the microscope lens"
• Sometimes I can think that I am focusing attention and concentrating and then discover that I wasn't and that there was a whole part of the experience I missed. • I noticed that in the mornings it is easier for me to focus attention and concentrate. There are less thoughts and their rate is slower. • I noticed that the attention system prefers steady objects to focus upon and less dynamic, such as a steady noise, or looking at a still object. • I noticed that when attention is focused on the breath and the body the physical system becomes calmer. • Expectation and motivation to succeed can distract attention. • Repeating the same exercise influences attention levels. In other words, when training several times on the same exercise, the levels of attentions and concentration improves from session to session. • Attention to something can silence another feeling/thought, for example, attention to thoughts silences the external world and the "noise" that accompanies it.
Investigating magnets of attention
• I noticed that my emotional state influences my ability to concentrate. When my arousal is high (for example in a state of anger or excitement) it is harder to focus. • I noticed that when my attention is focused on a sensory stimulus or is temporarily distracted by a sensory stimulus, it is relatively easy to bring the attention back and refocus. When the emotional system is activated by an emotion or thought it distracts the ability to focus. After that it is very hard to refocus attention. • When attention is distracted to an external stimuli, sometimes a physiological and an emotional response accompanies it and sometimes it doesn't. • When the external stimuli is passing and transient (cars passing or honking), attention quickly returns to the breath and internal concentration. But when the external stimuli is continuous (car engines, people talking) it is hard to bring attention back to the breath.
Investigating the relationships between emotions, sensations, and thoughts
• I noticed that thoughts stimulate feelings that involve bodily sensations. [Also] I noticed that bodily sensations (for example, unpleasant sensation or pain in a certain area) can stimulate feeling and thoughts. • When the trigger is an internal physiological sensation in the body (for example, a sensation of pain, even very light pain), there arises an unpleasant feeling of pressure in the stomach. After that comes thoughts that are quite "technical" and are related to that bodily sensation (Why am I in pain?). • When the thoughts were "neutral" general thoughts about life, thoughts that come and go, I didn't notice any physical sensation that accompanied them. When the thoughts were disturbing thoughts (something I did wrong, something I need to do), there was an unpleasant sensation in the chest that accompanied them. • I noticed that in a transition from one environment to another the body tries to adapt to the state of the new environment, e.g., the weather. For example, [the body contracts] before entering a state that is cold. • I noticed a connection between the sensory system and the emotional system, so that when I feel a sensation, immediately certain feelings arise which then enhance the sensory sensation, and so on. A bi-directional route. • I noticed that the mood I start the day with has a significant influence on my attention system, my thoughts throughout the day, and my feelings and physical sensations.
Investigating emotional valance
• I noticed that the attention system is influenced more by negative stimuli than by positive ones and it's more difficult for it to detach from the negative stimuli. • I noticed that when I move my awareness [and concentration] to a certain body area, [a feeling of restfulness] develops there. Attending to certain areas leads to a pleasant sensation in an itchy area. • I noticed that focusing on a painful area, being in that moment with the pain, not fighting it and just accepting it leads to a reduced sense of pain. • I noticed that focusing on a certain area enhances and sharpens the bodily sensations in it. • Negative emotions narrow down the attention beam and positive emotions widen it.
Investigating the relation between intrinsic and extrinsic processes
• When attention is [needed for] a task that requires a skill or knowledge like arithmetical calculation, it is hard to keep focused [on the breath], and high chances that attention will be [entirely] diverted to the skill required in the task. • The type and difficulty of the task influences a person's attention level and focus. When the task is challenging, we concentrate on it, and it would not be easy to shift our attention to less challenging tasks. • I notices that when counting back most of my attention resources are allocated at the counting itself. The only times I suddenly noticed the feeling of my body's posture was when the subtraction of the two numbers was easy for me. • I noticed that every thought or feeling slowed down my ability to count-back. • In a world full of stimuli it is easy to get "absorbed" in them and forget about yourself.

These examples were taken from students' weekly "lab-reports" as well as from their list of insights that they submitted in the end of the semester (after they went over all their lab reports and reflected upon the whole process). Here we only give examples for the investigations we mentioned in the Methods Section. For more examples of investigations and observations—see Supplementary Section.

Table 3 | Ratings of satisfaction, learning, and future-intention to use contemplation tools following in-class weekly investigations, among bonus-track students.

	Mean (scale from 1 = lowest to 5 = highest)	Standard deviation	*N*
Grade the rate of satisfaction you obtained from the investigations.	3.84	0.99	64
How much do you feel you learned from these investigations?	3.75	1.02	65
Do you think you will use the contemplative tools you received in this course in the future?	3.75	1.00	65

High average ratings were obtained, compared to the midpoint of the scales (One-sample t-tests, all p's < 0.001).

Table 4 | Ratings of satisfaction, learning, future-intention to use contemplation tools and importance to combine brain investigations in the training process, among students who participated in the bonus track investigations.

	Mean (scale from 1 = lowest to 5 = highest)	Standard deviation	*N*
Grade the rate of satisfaction you obtained from the investigations.	4.00	0.90	65
How much to you feel you learned from these investigations?	4.08	0.87	65
Do you think you will use the contemplative tools you received in this course in the future?	3.89	1.04	64
How important is it, in your opinion, to combine "personal brain investigation" in the training process of psychology students?	4.13	0.93	68

High average ratings were obtained, compared to the midpoint of the scales (One-sample t-tests, all p's < 0.001).

feeling in relation to the investigation process: "the bonus-track was a daily pause for me, to stop and look at things that interest me but I don't always have the time to investigate and learn about myself. The first time I did it was for the experience, the second investigation I did for the grade, but all the subsequent investigations I did because of enjoyment and curiosity" (Student 97). Student 84 wrote: "I enjoyed performing most of the tasks and noticing the changes and the things that are happening."

Interest. A majority of students (64%) reported feeling the process they had undergone during the semester was interesting: "It was very interesting to discover new things about myself and

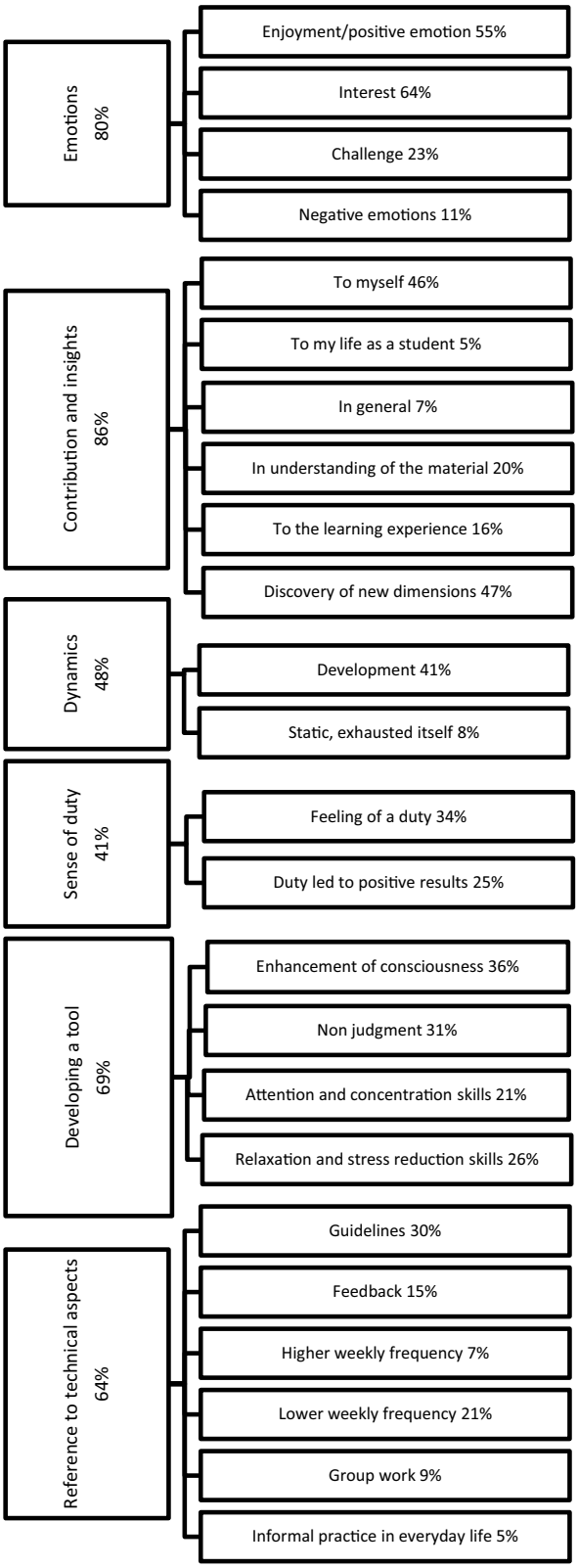

FIGURE 1 | The six core themes identified in the qualitative analysis. Presented are also the sub-categories for each theme, with the corresponding percentage of students who included them in their reports.

about phenomenon that happen while directing attention in various ways and during daily activities that I preform (Student 39). Student 79 wrote: "Along the way I came across some interesting and fascinating exercises that stimulated the desire to explore, understand and learn." Student 86 wrote: "The process was very interesting. I tried to explore and discover new things and there were times when I was indeed very surprised about what I found."

Challenge. Some students (23%) reported that the process included a challenge and was effortful: "Attention is a very elusive creature that depends upon situations in a very dynamic manner" (Student 12). "I found it really hard for me to release control and focus my attention. Maybe this frustration is what led to my extra effort in the practice of the exercises" (Student 42). Student 98 wrote: "At first the tasks were very difficult; I found it hard to focus my attention." Student 100 wrote: "Exercises that involved attending to specific body organs were more difficult for me."

Negative emotions. A small number of students (11%) reported negative emotions: "I felt discomfort" (Student 56). Student 90 wrote: "The total detachment from distractors and the silence created unpleasant and negative feelings." Student 4 wrote: "The experience was interesting in part, but I did not connect to many practices and they bored me (the practice was technical)."

Contribution and insights

The second core theme related to contributions and insights that the investigation process elicited and appeared in most of the reports (86%).

Contribution to myself. About half of the students reported a personal contribution (46%): "I discovered a lot of new things about myself. I revealed a new perspective, instead of looking outwards, to focus inwards. That is something that I never experienced personally before. This is a very instructive and enriching experience. Most of the learning was about myself, about the rich world and the interaction between the two" (Student 10). Student 11 wrote: "Although the aim of these investigations was not to look at myself and or to improve myself, I think they mostly contributed in this dimensions. I think that however I thought I was aware of my feelings beforehand, I am bit more aware of them today."

Contribution to my life as a student. A few students (15%) noted contributions to them as students in general (not specifically related to the neuroscience class): "the exercises enabled a "time out" for self-observation that was very needed in this over-loaded semester" (Student 31). Student 24 wrote: "I felt that the ability to breakout from the pressure of life in general, and school in particular, and to focus on these investigations, was a present and induced a more relaxed and calm atmosphere."

Contributions in general. Some students (7%) reported a broadly general contribution: "It contributed to understanding the various physiological and psychological effects through actual experience" (Student 82). Student 62 wrote: "[There was] a legitimacy to look inside and sense things that I wouldn't bring to mind if it wasn't for the brain investigations. Just as we study the psyche, it is important to learn on our bodies and ourselves the connection between body and mind."

Contribution to understanding of the material. About fifth of the students (20%) reported a better understanding of the material: "I think that the brain investigations give a different perspective to the curriculum which is a unique pedagogic approach" (Student 82). Student 14 wrote: "In general I believe that a good learning process needs to include some personal experience that relates to the learned material, and I think that this process enables this. Such an experience provides depth to the contents of the course and enables a completely different learning experience from the common one. We are used to receiving information from the teachers and books; such a personal experience enables a completely different level of processing."

Contribution to the learning experience. Some students (16%) reported a contribution to their learning experience: "I think the idea to enable an experiential dimension along the course is positive and very much needed especially in a psychology degree where everything is so theoretical. This enables reflecting on the class material beyond reading class summaries and enables feeling connected with the class material. They should consider doing this in other courses too" (Student 28). Student 22 wrote: "This training contributed to me personally and made me think about a lot of things that I never thought about in the past. It really added to the learning experience in this course and helped in the understanding of the material." Student 41 noted: "It contributed to learning. To experience something is not just like reading or learning about it."

Discovery of new dimensions and insights. About half the students (47%) reported the discovery of new dimensions in relation to brain and mental processes and their relation to their environment: "it was the first time I noted the actions that I do, the physical activity that is usually automatic, I felt every movement and investigated how they are done. I think I had experiences that I wouldn't have had an opportunity to investigate in any other place" (Student 17). Student 22 wrote: "I think this exercise contributed also personally and caused me to think about things I never thought about in the past."

Dynamics

The third core theme related to the nature of the students' experiences—whether they reported a dynamical experience, which evolved and changed throughout the semester or a static one. Mentioning of this appeared in 48% of the summaries.

Development. A little less than half of the students (41%) mentioned the presence of a dynamic process that developed and evolved throughout the semester: "I think that the exercises had a developmental trajectory, therefore there is not a single exercise that I would give up" (Student 8). Student 67 noted: "While summarizing the tasks that I submitted, I was amazed to realize the process that I went through week after week." Student 58 wrote: "At first I didn't realize how such simple exercises can bring great insights. However, with the passage of time and while performing

more and more exercises, I was surprised to find how much you can learn from something so simple."

Static, exhausted itself. A number of students (8%) reported feeling that the process did not develop and was static most of the time. Student 3 wrote: "Most exercises were really interesting, but there were times that I felt a sense of exhaustion and did not understand why we have to practice the same exercise again." Student 9 wrote: "The content of the trainings was very similar most of the times, so the exercises became sometimes tedious and ineffective."

Sense of duty

The fourth core theme related to a sense of duty and obligation evoked by the process and appeared in 41% of the summaries. We divided them to those that explicitly mentioned feeling of duty to those that mentioned the duty in relation to positive outcomes.

Feeling of a duty. About one-third of the students reported a feeling of duty (34%). However, only 17% reported a sense of duty without also reporting positive results: Student 72 wrote: "There were times when I was stressed and performed the exercises out of duty, but not in most cases." Student 53 wrote: "The experience was mostly interesting, but at its end I felt I was doing it from a feeling of duty." Student 93 wrote: "There were several times when I felt a sense of duty and therefore, in those times I connected only during exercise itself."

Duty led to positive results. A quarter of the students (25%) reported feeling that the duty had positive outcomes. Student 68 wrote: "Without the [repeated] practice I would have never performed exercises of this type, because normally we relate to the body as a machine without needs." Student 46 commented: "I understand that it is important to practice a large number of times in order to obtain results and insights." Student 83 wrote: "I would not give up to the fact that weekly assignment had to be submitted on the same day and at the same time every week. The fact that the investigations were performed continuously for more than 2 months, made the process deep and interesting."

Developing a tool

The fifth core theme related to the development and acquisition of some tool or skill and appeared in 69% of students' reports.

Increased awareness. A third of the students (36%) noted an increased awareness: "It is nice to raise the level of awareness to things that without the exercises I wouldn't necessarily be aware of" (Student 5). Student 21 wrote: "I realize I have developed a skill…now, occasionally, there are moments that I suddenly notice details I have not noticed in the past. This happens every few days, but it is interesting and also gives a good feeling." Student 10 elaborated: "The exercises provided me with a different perspective, helped me become aware of myself, of my body, of my breath, of my movement, of how various stimuli distract me from experiencing my inner experiences."

Non-judgment. A third of the students (31%) reported feeling that they had developed the ability of looking at things in a non-judgmental way, enabling a different perspective at things. Student 45 wrote: "I let myself investigate all the small things that constitute me, without trying to fix it. To try as much as I can to investigate, to focus and polish the lens." Student 94 wrote: "I became less and less judgmental toward myself, even in advanced exercises which I did not succeed. This is an achievement by itself; to be in the process and not necessarily reach the target. The result is not less interesting."

Attention and concentration skills. A fifth of the students (21%) noted the development of better attention and concentration abilities: "my ability to focus attention improved or at least rose to a higher level of awareness" (Student 18). Student 19 mentioned: "with time, attention allocation become more automatic, without relation to the specific instructions for the week." Student 39 wrote: "the order of the exercises was meaningful, since as the weeks past I felt I became more skillful in focusing attention, and I could do more complex tasks that I assume I couldn't have done in the first weeks."

Relaxation and stress reduction skills. Another ability that some students (26%) reported as the result of the bonus-track process related to ability to reduce, regulate, and cope with stress. Student 82 wrote: "I am an anxious person by nature. I and my close relatives can attest that lately the exercises helped me significantly in relaxing." Student 47 commented: "Unfortunately, due to the large load and amount of tasks that we get, we do not always have the time to stop and breathe and be with ourselves. The exercise was a good attempt to allow us such quality time." Student 29 wrote: "I felt this helped me to deal with stress and various feelings. In addition, it was interesting to connect to myself and just be in peace and serenity with myself for 10 min every day."

Reference to technical aspects

The sixth and last core theme, which appeared in 64% of the summaries, related to technical aspects of the process and suggestions for improvement.

Guidelines. A third of the students (30%) commented on the guidelines. In general, students reported feeling the guidelines were important: "The practice at the beginning of class, was very powerful and gave us an introduction to what is expected from us, how to work during the week" (Student 33). "I would leave [for future bonus-track exercises] the slight vagueness in which the guidelines were given…and the explanations about polishing and focusing the lens in the first weeks that helped perform the exercise subsequently" (Student 61). Some students felt they needed even more precise instructions, such as Student 77: "I think I'd sharpen more the instructions, especially at the first few weeks and I'd love to get a bit more detailed feedback."

Feedback. Some students (15%) specifically mentioned the feedback provided by the teacher: "I liked the fact that you gave feedback, even just the word "thank you"; it helped me to know that I am doing things right and that you really care and are interested in my investigations" (Student 69). Student 74 wrote: "I would continue [for future students] the persistence to investigate the processes with an "investigator's eye" and not from a

psychological perspective." Student 95 commented: "I would add feedback in the form of questions. Once you asked me what I meant when I said "soul." This question made me think beyond, and contributed to my process."

Higher weekly frequency. A few students (7%) reported they would have liked a higher frequency of exercises (i.e., more than 4 times a week): "I wouldn't change the fact you need to report 4 observations a week because every observation enables you to look at the exercise from a different perspective and in that way discover more" (Student 59). "I would stay with four weekly observations since there are real difference when you perform the exercise in different places, different moods, different hours, etc." (Student 78).

Lower weekly frequency. A fifth of students (21%) reported they would have preferred a lower frequency of exercise: "I think that it was enough to report only three times a week since the fourth time was already too much of a burden and sometimes made me forget the main reason for doing the exercise" (Student 18). "Although the exercises are only 10 min a day, I felt the requirement to do them four times a week was a bit exaggerated" (Student 48).

Group work. A few students (9%) commented on the benefits of group work: "I would set at least two exploration tasks to work on pairs so we can see how the same questions and guidelines are interpreted and experienced differently by each person. It is important that we also see the inter-individual differences" (Student 97). "I would have been happy if once all the participants in the bonus-track can meet and share experiences, I think this could have been interesting" (Student 14).

Informal practice in everyday life. Only 6% of the students mentioned the informal practices that were given as additional suggestions for everyday life. Student 21 wrote: "I think the informal practice helped me much as it enabled me to see how the investigations are reflected in daily life." Student 50 wrote: "It is important [for future students] to continue with the informal practices that for me, at least, enabled the most interesting discoveries."

DISCUSSION

Contemplative pedagogy is becoming increasingly popular and has recently been introduced to a variety of subjects ranging from poetry to medicine to law (Zajonc, 2013). Inspired by Buddhist contemplative methods of investigation and the emerging field of contemplative neuroscience, we suggested a way of introducing methods of contemplative pedagogy into the teaching of neuroscience in the form of an "experimental contemplative lab" with "personal brain investigations." We provided examples of short 10-min investigations that students were asked to do in the beginning of our weekly neuroscience class, as well as longer weekly investigations they could perform at home. These investigations enabled students to focus awareness and attention in a non-judgmental way to sensory, emotional, motor, cognitive, motivational, and arousal processes, and even to awareness and attention themselves—all brain processes that are taught in advanced neuroscience courses.

Using both quantitative and qualitative measures, we evaluated the contribution of these contemplative investigations to course learning and to student satisfaction, as well as to the ability to appreciate the usefulness of contemplative tools.

Our quantitative evaluations revealed that students who performed both the short in-class investigations and the longer bonus-track ones, expressed significant satisfaction from both formats of investigations and reported feeling the investigations contributed to their learning process. All these students also reported that the contemplative tools they acquired might be useful to them in the future. Bonus-track students also reported feeling that it is important to combine similar exercises in the training of psychology students in general. A similar trend was also obtained for students who participated in the in-class investigations only, albeit not significant, probably because of the low statistical power due to the small number of students available for this analysis. Analyzing final grades of all students revealed that students that chose to take the bonus track were *a priori* stronger students (as reflected by analyzing their grades from the previous basic neuroscience course—see Section Descriptive statistics of students in Materials and Methods), thus their better grades in the advanced neuroscience course could not be attributed necessarily to the bonus-track process (as shown in the analysis of covariance presented in Section Grades of the Results). Since we did not have the final grades of the students that only participated in class, we cannot, at this point, claim that the contemplative methods contributed to improvement in class grades.

The 1-year follow-up quiz enabled us to investigate whether the brain investigations made a contribution to learning that went beyond providing students with a positive experience. A year after the completion of the course, students that participated in the bonus-track brain investigations were much more likely (even when final grade range in the course, percentage of classes attended, participation during class and concentration levels were used as covariates) to remember the course material relative to those that did not participate in the bonus-track. This finding suggests that extensive participation in the "personal brain investigations" not only contributed to the students' experience but also enriched and enhanced the representations of the class material leading to superior subsequent memory for the class information.

Our qualitative evaluation enabled a more fine-grained understanding of the process that the bonus-track students underwent. In this evaluation, we extracted themes that emerged in the written reflections of the bonus-track students. As students were not asked explicit questions in the final reports, the spontaneous emergence of a theme and its occurrence across individuals contains important insights regarding the contribution of the contemplative exercises to the students. First, we found that in accordance with the significant satisfaction scores that bonus-track students reported on the quantitative evaluations, the qualitative analysis revealed that most of them reported feeling positive emotions toward the contemplative investigations, such as interest (64%) and feelings of enjoyment and enrichment (55%). Only 11% reported negative emotions such as discomfort, boredom

and unpleasant sensations (and the intensity of such emotions was small relative to the reports of positive feelings). Moreover, almost half of the bonus-track students (46%) reported feeling that the process contributed directly to their personal lives and provided them with new insights and discoveries (47%) regarding themselves. The feedback from one of the students exemplifies the experience of many bonus-track students: "I discovered a lot of new things about myself. I discovered a new perspective, instead of looking outwards, to focus inwards. That is something that I never experienced personally before. This is a very instructive and enriching experience. Most of the learning was about myself, about the rich world and the interaction between the two."

In accordance with the quantitative results, the qualitative analysis of bonus-track students' summaries revealed that the contemplative exercises did not only add to students' general experiences but also contributed directly to their in-class learning. Close to one-third of the bonus-track students (27%) spontaneously reported that the investigations contributed to their understanding of the class material and to their learning experience. They mentioned that experiencing the theoretical material taught in class first-hand "provides depth to the course content" and "enables a completely different level of processing" beyond that provided by traditional reading or learning processes. Students in the bonus track mentioned that the personal brain investigations "connected the self to the theoretical course material." Based on our personal teaching experiences, we can attest to the fact that psychology students (as well as students of other therapy-based professions) often find it hard to understand how biological courses relate to other courses in their undergraduate studies. Our findings suggest that contemplative exercises, such as the ones we proposed here, can be an effective way to bridge psychological and physiological processes and provide motivation to psychology students to learn about biological processes.

Notably, our qualitative analysis revealed that many bonus-track students reported being able to cultivate various contemplative skills during the semester. Bonus-track students reported an increased awareness of themselves and their environment (36%), the development of a non-judgmental attitude toward subjective experiences (30%) and the enhancement of their attentional skills (21%). Although the personal brain investigations did not explicitly cultivate these skills, this by-product was not unexpected. This is because the mindfulness skill set—namely "focusing attention, on purpose, in a particular way and non-judgmentally," as Kabat-Zinn (1994) defined it—served as the basis for our contemplative approach. Thus, the fine-tuning of attention and awareness in the beginning of each investigation, and the non-personal, researcher-like stance bonus-track students were required to take upon themselves, enabled some of them to generalize these abilities to their daily lives.

Another skill, which approximately one-quarter of bonus-track students (26%) spontaneously reported cultivating during the process, was an improved ability to withstand the stresses and challenges of the semester. This finding is in-line with the large body of research showing that mindfulness practice can be employed for the sake of reducing stress, depression and anxiety symptoms (Hofmann et al., 2010). Some bonus-track students specifically addressed this benefit in their lab reports: one wrote that "it seems that when attention is focused to the body's posture, the emotional system remains stable and uniform, without oscillations in mood," and another stated that "even just the polishing of the lens and the focusing on the breath helps relax the body and the thoughts."

The fact that bonus-track students explicitly mentioned the cultivation of healthy mind skills is in accord with our quantitative findings that students claimed to want to use these contemplative tools in the future. The qualitative analysis also showed that bonus-track students not only identified these skills as being beneficial for their well-being and academic achievements during their stressful and challenging college year (see examples of reports in Section Developing a tool of Results), but also as being highly relevant for their future careers as therapists.

Taking the qualitative and quantitative evaluations together, we suggest that using contemplative exercises, such as the personal brain investigations we described here, can enrich neuroscience classes, help psychology students relate theoretical biological material to their personal experiences and professional lives, and contribute to learning and memory processes. In addition, these contemplative exercises can enable students to discover new insights about themselves, as well as cultivate contemplative tools and gain valuable skills to enhance their personal well-being and learning abilities.

Although most current advances in neuroscience pedagogy focus on incorporating technological tools to assist neuroscience teaching (Griffin, 2003; Estevez et al., 2010), several educators are seeking more experiential ways to help students connect the course content to their lives and increase motivation, engagement, and curiosity toward the theoretical class material (Stewart and Stavrianeas, 2008; Pollack and Korol, 2013). The "experimental contemplative lab" that we presented here provides students with hands-on access to mental and psychological processes related to class material and the possibility to explore and develop curiosity toward them. In some sense, contemplative methods make explicit the attempts made by students, often implicitly, to relate theoretical class material to their everyday life experiences. Importantly, such contributions of contemplative methods are not limited to undergraduate neuroscience courses for psychology students but can be implemented with a wide range of student ages and levels.

Several limitations of our evaluation methods should be considered. The first concerns the external validity of our results. Bonus-track students comprised 40% of the total student cohort and participation in the bonus track was based on the student's willingness to volunteer (and/or obtain the bonus points). In addition, bonus-track students had, on average, higher grades than the other students from the very beginning. Thus, it is not clear whether the positive effects that we found would also appear if all students were obliged to participate. However, it is important to note that approximately half of the students who participated in the bonus-track were below-average students (based on their grades the previous year, see Methods), suggesting the bonus-track is not only attractive to strong students.

Another limitation concerns the internal validity of our results. Differences between the bonus-track group and the other students could have been due to *a priori* dissimilarities between the

groups. For example, we know that bonus-track students were, on average, better students. In addition, it is possible that the bonus-track students were also more focused, less stressed, more positive toward neuroscience material, and attended class more. These qualities may have enabled them to obtain more benefits from the contemplative process, as well as influenced learning and memory processes. In the analysis of the follow-up quiz we controlled for grade, class attendance, class participation and level of concentration, however we did not control for the other factors. Thus, it is possible that the difference we found on the quiz was a consequence of various qualities characterizing the bonus-track students and not the contemplative investigations themselves. Indeed, we do not have direct information regarding students' general attitude toward neuroscience classes which may have facilitated motivation to remember class material. However, regarding the issue of stress and focus, the fact that around one-quarter of bonus-track students spontaneously mentioned how the process had helped them withstand the stress and challenges of the semester, and increase attention and focusing abilities, suggests that many of the bonus-track students are not necessarily different in these aspects from students who did not complete the bonus-track.

Another limitation concerns the fact that the available data does not allow us to assess separately the effects of the in-class investigations and the effects of the bonus-track. Thus, we cannot conclude whether the in-class investigations, by themselves, can contribute to neuroscience teaching. In addition, the bonus track involved a bi-weekly personal feedback from the teacher, considerable written assignments and a bonus credit. All of these could have contributed more than the contemplative exercises themselves to the positive outcomes found for the bonus-track students. Although we cannot rule this out, the fact that several themes that arose from bonus-track students' spontaneous reports were explicitly related to the development of various contemplative skills ("increased awareness," "non-judgment," "attention and concentration"), suggests that the contemplative aspects of the exercises had a non-negligible contribution to the effects of bonus track.

A fourth limitation relates to the fact that the teacher (first author) was involved in the qualitative analysis, possibly introducing a bias in the analysis. Although this design is of course not optimal, we took caution to attenuate bias as much as possible (see Methods sections for details). We believe the existence of many thematic categories that describe difficulties and negative emotions toward the bonus-track program (such as "negative emotions," "feeling of challenge," feeling it was "static, exhausted itself," "feeling a sense of duty") suggest that the coders were not biased toward positive outcomes only. Finally, it is important to emphasize that the third coder who performed the final coding of all diaries was naïve to the goals of the manuscript.

An additional limitation of the study arises from the fact that the qualitative results may have been biased by the bonus-track students' desire to appease the teacher by submitting positive reflections in their final report. However, the large diversity of themes that extended beyond the examples given in the instruction of the assignment, and the fact that there were also several negative themes suggests students made an effort to reflect upon their experience and were not concerned about expressing negative thoughts and feelings. In addition, we believe that the non-judgmental stance of the teacher throughout the course encouraged students to be authentic regarding their reports of their experiences.

Despite these limitations, when viewing our results alongside the growing enthusiasm about the use of contemplative methods in higher education (Bush, 2011; Barbezat and Bush, 2013; Zajonc, 2013), the increasing interest in contemplative neuroscience tools (Varela et al., 1992; Lutz et al., 2007; Lutz, 2010; Desbordes and Negi, 2013) and the growing number of reports on the positive effects of mindfulness-based practices on students' achievements and well-being (Beauchemin et al., 2008; Shapiro et al., 2008; Mrazek et al., 2013), we believe the effects we are reporting are related to the contemplative exercises described here and can be generalized to a wide range of students.

Notwithstanding the important pedagogical contributions that the contemplative approach discussed here may have, it is important to note that its implementation may not be straightforward. The major reason for this is the fact that the success of this approach draws upon the teacher's personal internal resources, skills, and expertise. A teacher, who wishes to use contemplative tools in a neuroscience class, should be able to guide students during their personal brain investigations, propose questions for inquiry, and most importantly, help them acquire an investigative, non-judgmental stance. As can be seen from the qualitative analysis (Section Reference to technical aspects in Results), some students would have liked to have been provided with specific instructions regarding what to do and what to discover. However, the essence of the contemplative approach is that it enables students to investigate their experience as it evolves, incorporating all aspects of the experience into the inquiry process. It is therefore important that the feedback and guidance from the teacher is not goal-oriented and that it leaves space for unexpected discoveries. The ability to be in a state of equanimity and curiosity with everything that happens is a skill the teacher should cultivate; we recommend that the teacher spend time acquiring contemplative attitudes of inquiry and experiencing various personal brain investigations firsthand. Importantly, though the pedagogical approach described here is greatly inspired by mindfulness practice, it is not *a* mindfulness practice. In mindfulness practice one develops the mindfulness skill set (i.e., concentration and attention stability, perceptual clarity and equanimity) in order to nurture a deep awareness toward the relation between habitual reactions to mental and sensory events to psychological suffering, and the transient nature of all phenomenon (Grabovac et al., 2011). In the "experimental contemplative lab," on the other hand, the mindfulness "skill set" is developed for a more modest aim—that of supporting the investigative process of specific mental processes relevant to class material. Although students may spontaneously generalize these abilities to gain wisdom and insights regarding their personal lives (for example, see Section Contribution and insights in Results), they are not explicitly led to do so. Thus, we believe that a teacher that has basic training in contemplative inquiry and has mastered to some level the mindfulness "skill set" can lead students through successful experiences of "personal brain investigations." Although,

gaining basic mindfulness skills is not challenging these days, given the wide availability of secular mindfulness-based courses (such as Jon Kabat-Zinn's 8-week MBSR course, Kabat-Zinn, 2013), this basic requirement naturally limits the contemplative approach to teachers who are willing and curious of these directions.

This point relates to the next one, which is the difficulty to provide "manuals" and ready-made kits for such a contemplative approach. Here, we provided only several examples of many possible personal brain investigations that can be conducted. We believe that the ability of a teacher to lead students through "personal brain investigation" relies on the teacher's personal experience and thus teachers should develop their own investigations. To do so, one should be reminded that relating theoretical class material to human experience is a natural process that occurs on a daily basis in psychology teaching courses. By bringing contemplative inquiry skills into this process, teachers can develop their own suggestions for contemplative investigations related to their specific class material and personal experiences. Additional suggestions for those who would like to implement a contemplative approach similar to ours in their class are provided in the Supplementary Section.

Finally, another reason why implementation of the contemplative approach may not be straightforward, relates to the fact it is a first-person method. As discussed above, first-person methods have significant shortcomings as a method of investigation due to the fact that they are highly subjective and difficult to verify (Overgaard et al., 2008). However, as more neuroscience studies attempting to use first-person tools are emerging (Lutz et al., 2002; Petitmengin et al., 2006; Dor-Ziderman et al., 2013), one can expect that contemplative neuroscience pedagogy will become more appreciated as well. We believe that the advantages and shortcomings of contemplative methods can be directly experienced in a pedagogical setup. In addition to discussing the limitations of contemplative methods as scientific tools in class, teachers should provide a means for students to directly experience the inter-subject variability in first-person reports (see student mentions of this issue in Section Group work in the Results). Opportunities to experience such inter-individual differences can be provided in a variety of ways, such as sharing observations in class, working in pairs or small groups, or uploading selected observations to a common virtual forum on the class website.

In summary, we have described here a contemplative approach for neuroscience teaching. Our pilot study suggests that this approach can contribute significantly to students learning and experience, as well as development of important learning skills such as attention and emotional regulation. Despite our initial results, further investigations are required to assess the effectiveness of such pedagogical approach. In addition, the implementation of such pedagogical approach is not straightforward as the prerequisites required from the teacher entail significant personal investment. Yet, such efforts are worthwhile. As the field of neuroscience moves toward the understanding of the most complex human experiences (e.g., Varela et al., 1992; Lutz, 2010; Desbordes and Negi, 2013) and is becoming more integrated in diverse fields of study, the ability to connect different levels of knowing is an important tool for future generations of investigators and therapists.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: http://www.frontiersin.org/journal/10.3389/fpsyg.2014.01296/abstract

REFERENCES

Allard, D. W., and Barman, C. R. (1994). The learning cycle as an alternative method for college science teaching. *BioScience* 44, 99–101. doi: 10.2307/1312208

Av-Ron, E., Byrne, J. H., and Baxter, D. A. (2006). Teaching basic principles of neuroscience with computer simulations. *J. Undergrad. Neurosci. Educ.* 4, A40–A52.

Barbezat, D. P., and Bush, M. (2013). *Contemplative Practices in Higher Education: Powerful Methods to Transform Teaching and Learning*. Hoboken, NJ: John Wiley & Sons.

Beauchemin, J., Hutchins, T. L., and Patterson, F. (2008). Mindfulness meditation may lessen anxiety, promote social skills, and improve academic performance among adolescents with learning disabilities. *Complementary Health Practice Review* 13, 34–45. doi: 10.1177/1533210107311624

Blank, L. M. (2000). A metacognitive learning cycle: a better warranty for student understanding? *Sci. Educ.* 84, 486–506. doi: 10.1002/1098-237X(200007)84:4%3C486::AID-SCE4%3E3.0.CO;2-U

Brady, R. (2007). Learning to stop, stopping to learn discovering the contemplative dimension in education. *J. Transform. Educ.* 5, 372–394. doi: 10.1177/1541344607313250

Brann, D. W., and Sloop, S. (2006). Curriculum development and technology incorporation in teaching neuroscience to graduate students in a medical school environment. *Adv. Physiol. Educ.* 30, 38–45. doi: 10.1152/advan.00068.2005

Braun, V., and Clarke, V. (2006). Using thematic analysis in psychology. *Qual. Res. Psychol.* 3, 77–101. doi: 10.1191/1478088706qp063oa

Bush, M. (2011). Mindfulness in higher education. *Contemporary Buddhism* 12, 183–197. doi: 10.1080/14639947.2011.564838

Colburn, A., and Clough, M. P. (1997). Implementing the learning cycle. *Sci. Teacher Washington* 64, 30–33.

Corbetta, M., and Shulman, G. L. (2002). Control of goal-directed and stimulus-driven attention in the brain. *Nat. Rev. Neurosci.* 3, 201–215. doi: 10.1038/nrn755

Davidson, R., Dunne, J., Eccles, J. S., Engle, A., Greenberg, M., Jennings, P., et al. (2012). Contemplative practices and mental training: prospects for American education. *Child Dev. Perspect.* 6, 146–153. doi: 10.1111/j.1750-8606.2012.00240.x

Denzin, N. K., and Lincoln, Y. S. (1994). *Handbook of Qualitative Research*. Thousand Oaks, CA: Sage.

Desbordes, G., and Negi, L. T. (2013). A new era for mind studies: training investigators in both scientific and contemplative methods of inquiry. *Front. Hum. Neurosci.* 7:741. doi: 10.3389/fnhum.2013.00741

Dorjee, D. (2010). Kinds and dimensions of mindfulness: why it is important to distinguish them. *Mindfulness* 1, 152–160. doi: 10.3389/fnhum.2012.00018

Dor-Ziderman, Y., Berkovich-Ohana, A., Glicksohn, J., and Goldstein, A. (2013). Mindfulness-induced selflessness: a MEG neurophenomenological study. *Front. Hum. Neurosci.* 7:582. doi: 10.3389/fnhum.2013.00582

Ekman, P., Davidson, R. J., Ricard, M., and Wallace, B. A. (2005). Buddhist and psychological perspectives on emotions and well-being. *Curr. Dir. Psychol. Sci.* 14, 59–63. doi: 10.1111/j.0963-7214.2005.00335.x

Estevez, M. E., Lindgren, K. A., and Bergethon, P. R. (2010). A novel three-dimensional tool for teaching human neuroanatomy. *Anat. Sci. Educ.* 3, 309–317. doi: 10.1002/ase.186

Freberg, L. (2009). *Discovering Biological Psychology*. Hampshire: Cengage Learning.

Gallagher, S., and Varela, F. J. (2003). Redrawing the map and resetting the time: phenomenology and the cognitive sciences. *Can. J. Philos.* 33, 93–132.

Grabovac, A., Lau, M., and Willett, B. (2011). Mechanisms of mindfulness: a Buddhist psychological model. *Mindfulness* 2, 154–166. doi: 10.1007/s12671-011-0054-5

Griffin, J. D. (2003). Technology in the teaching of neuroscience: enhanced student learning. *Adv. Physiol. Educ.* 27, 146–155. doi: 10.1152/advan.00059.2002

Harrington, I. A. (2013). Can you change a student's mind in a course about the brain? Belief change following an introductory course in biological psychology. *J. Undergrad. Neurosci. Educ.* 12, A23–A33.

Hart, T. (2004). Opening the contemplative mind in the classroom. *J. Transform. Educ.* 2, 28–46. doi: 10.1177/1541344603259311

Hofmann, S. G., Sawyer, A. T., Witt, A. A., and Oh, D. (2010). The effect of mindfulness-based therapy on anxiety and depression: a meta-analytic review. *J. Consult. Clin. Psychol.* 78, 169–183. doi: 10.1037/a0018555

Jack, A. I., and Roepstorff, A. (2002). Introspection and cognitive brain mapping: from stimulus–response to script–report. *Trends Cogn. Sci.* 6, 333–339. doi: 10.1016/S1364-6613(02)01941-1

Kabat-Zinn, J. (1994). *Wherever You Go, there You are: Mindfulness Meditation in Everyday Life*. New York, NY: Hyperion Books.

Kabat-Zinn, J. (2013). *Full Catastrophe Living, Revised Edition: How to Cope with Stress, Pain and Illness using Mindfulness Meditation*. London: Hachette.

Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development*, Vol. 1. Englewood Cliffs, NJ: Prentice-Hall.

Lawson, A. E. (2000). A learning cycle approach to introducing osmosis. *Am. Biol. Teacher* 62, 189–196. doi: 10.1662/0002-7685(2000)062[0189:ALCATI]2.0.CO;2

Lutz, A. (2010). Potential contributions of research on meditation to the neuroscience of consciousness. *New Horiz. Neurosci. Conscious.* 79, 281. doi: 10.1075/aicr.79.34lut

Lutz, A., Dunne, J. D., and Davidson, R. J. (2007). "Meditation and the neuroscience of consciousness: an introduction," in *The Cambridge Handbook of Consciousness*, eds P. Zelazo, M. Moscovitch, and E. Thompson (Cambridge, MA: Cambridge University Press), 499–554.

Lutz, A., Lachaux, J. P., Martinerie, J., and Varela, F. J. (2002). Guiding the study of brain dynamics by using first-person data: synchrony patterns correlate with ongoing conscious states during a simple visual task. *Proc. Natl. Acad. Sci. U.S.A.* 99, 1586–1591. doi: 10.1073/pnas.032658199

Lutz, A., and Thompson, E. (2003). Neurophenomenology integrating subjective experience and brain dynamics in the neuroscience of consciousness. *J. Conscious. Stud.* 10, 9–10.

Mason, M. F., Norton, M. I., Van Horn, J. D., Wegner, D. M., Grafton, S. T. and Macrae, C. N. (2007). Wandering minds: the default network and stimulus-independent thought. *Science* 315, 393–395. doi: 10.1126/science.1131295

Miller, G. A., Crocker, L. D., Spielberg, J. M., Infantolino, Z. P., and Heller, W. (2012). Issues in localization of brain function: the case of lateralized frontal cortex in cognition, emotion, and psychopathology. *Front. Integr. Neurosci.* 7:2. doi: 10.3389/fnint.2013.00002

Miller, J. P. J. (1994). Contemplative practice in higher education an experiment in teacher development. *J. Humanist. Psychol.* 34, 53–69. doi: 10.1177/0022167894034005

Mrazek, M. D., Franklin, M. S., Phillips, D. T., Baird, B., and Schooler, J. W. (2013). Mindfulness training improves working memory capacity and GRE performance while reducing mind wandering. *Psychol. Sci.* 24, 776–781. doi: 10.1177/0956797612459659

Overgaard, M., Gallagher, S., and Ramsøy, T. Z. (2008). An integration of first-person methodologies in cognitive science. *J. Conscious. Stud.* 15, 100–120.

Petitmengin, C., Baulac, M., and Navarro, V. (2006). Seizure anticipation: are neurophenomenological approaches able to detect preictal symptoms? *Epilepsy Behav.* 9, 298–306. doi: 10.1016/j.yebeh.2006.05.013

Pollack, A. E., and Korol, D. L. (2013). The use of haiku to convey complex concepts in neuroscience. *J. Undergrad. Neurosci. Educ.* 12, A42–A48.

Purves, D. (2008). *Principles of Cognitive Neuroscience*. Sunderland, MA: Sinauer Associates Inc.

Raffone, A., and Srinivasan, N. (2010). The exploration of meditation in the neuroscience of attention and consciousness. *Cogn. Process.* 11, 1–7. doi: 10.1007/s10339-009-0354-z

Raichle, M. E., and Snyder, A. Z. (2007). A default mode of brain function: a brief history of an evolving idea. *Neuroimage* 37, 1083–1090. doi: 10.1016/j.neuroimage.2007.02.041

Schettino, L. F. (2014). NeuroLab: a set of graphical computer simulations to support neuroscience instruction at the high school and undergraduate level. *J. Undergrad. Neurosci. Educ.* 12, A123–A129.

Schneider, B., Wallace, J., Blikstein, P., and Pea, R. (2013). Preparing for future learning with a tangible user interface: the case of neuroscience. *Learn. Technol.* 6, 117–129. doi: 10.1109/TLT.2013.15

Shapiro, S. L., Brown, K. W., and Astin, J. A. (2008). *Toward the Integration of Meditation into Higher Education: A Review of Research. Report Prepared for the Center for Contemplative Mind in Society*. Available online at: http://www.colorado.edu/ftep/events/eventdocs/documents/ShapiroResearchReport.pdf

Shapiro, S. L., Brown, K. W., and Astin, J. (2011). Toward the integration of meditation into higher education: a review of research evidence. *Teach. Coll. Rec.* 113, 493–528.

Stewart, M., and Stavrianeas, S. (2008). Adapting the learning-cycle to enrich undergraduate neuroscience education for all students. *J. Undergrad. Neurosci. Educ.* 6, A74–A77.

Strauss, A. (1987). *Qualitative Analysis for Social Scientists*. New York, NY: Cambridge University Press. doi: 10.1017/CBO9780511557842

Varela, F. J., Thompson, E. T., and Rosch, E. (1992). *The Embodied Mind: Cognitive Science and Human Experience*. Cambridge, MA: The MIT Press.

Waldvogel, J. A. (2006). "Mating Darwin with Dickinson: how writing creative poetry in biology helps students think critically and build personal connections to course content," in *Handbook of College Science Teaching*, eds J. J. Mintzes and W. H. Leonard (Arlington, VA: National Science Teacher Association Press), 185–194.

Wiertelak, E. P., and Ramirez, J. J. (2008). Undergraduate neuroscience education: blueprints for the 21st century. *J. Undergrad. Neurosci. Educ.* 6, A34–A39.

Young, S. (2013). *5 Ways to Know Yourself: An Introduction to Basic Mindfulness*. Available online at: http://www.shinzen.org/Retreat%20Reading/FiveWays.pdf

Zajonc, A. (2006a). Contemplative and transformative pedagogy. *Kosmos J.* 5, 1–3.

Zajonc, A. (2006b). Love and knowledge: recovering the heart of learning through contemplation. *Teach. Coll. Rec.* 108, 1742–1759. doi: 10.1111/j.1467-9620.2006.00758.x

Zajonc, A. (2013). Contemplative pedagogy: a quiet revolution in higher education. *New Dir. Teach. Learn.* 2013, 83–94. doi: 10.1002/tl.20057

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Why internet-based education?

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This essay illustrates five ways that Internet-based higher education can capitalize on fundamental principles of learning. Internet-based education can enable better mastery through distributed (shorter, more frequent) practice rather than massed (longer, less frequent) practice; it can optimize performance because it allows students to learn at their peak time of their day; it can deepen memory because it requires cheat-proof assignments and tests; it can promote critical thinking because it necessitates intellectual winnowing and sifting; and it can enhance writing skills by requiring students to write frequently and for a broad audience.

Keywords: Internet-based learning, online learning, higher education, asynchronous learning, depth of processing, optimal time of day, writing skills

WHY INTERNET-BASED COURSES?

Over 7 million post-secondary students in the United States – a third of all U.S. college and university students – were enrolled in an Internet-based course last year. Enrollment in Internet-based courses increased a whopping 440% during the past decade (Allen and Seaman, 2014). For the coming decade, most college and university presidents predict that all their students will take an Internet-based course (Parker et al., 2011). Internet-based higher education has moved "from a fad to a fixture" (Selingo, 2013, p. 97).

A decade ago, I volitionally moved all my University of Wisconsin–Madison courses onto the Internet. I wanted to harness the power of the Internet. I also wanted to harness fundamental principles of learning. In this essay, I will illustrate five reasons why Internet-based higher education can capitalize on principles of learning and, therefore, why Internet-based education can be effective pedagogy.

INTERNET-BASED HIGHER EDUCATION CAN LEAD TO BETTER MASTERY

A core principle of learning is that shorter, more-frequent episodes of practice lead to better mastery than longer, less-frequent episodes (Ruch, 1928; Oseas and Underwood, 1952; Underwood, 1961). Acquiring skills through more frequent practice is considered distributed learning, whereas acquiring skills through less frequent practice is considered massed learning. Distributed learning almost always trumps massed learning (Benjamin and Tullis, 2010).

Distributed learning's advantage over massed learning has been demonstrated for students of all ages (e.g., Seabrook et al., 2005), acquiring mastery in a wide range of courses (e.g., college composition, Kellogg and Raulerson, 2007; college biology, Reynolds and Glaser, 1964; and college statistics, Budé et al., 2010). Harness the pedagogical power of distributed learning has been one of the most common battle cries for improving higher education (e.g., Willingham, 2002; Roediger and Pyc, 2012).

Internet-based higher education enables more frequent engagement with the material than traditional face-to-face higher education (Holzinger et al., 2009). For example, at my university most face-to-face undergraduate classes meet only twice a week. Many seminar-style courses, including graduate-level courses, meet only once a week. While we professors would like to believe that our students continue to practice their skills when they are not in class, many students wait until the night before class meets to engage with the material. The students then attend class, but several days if not a week pass before the students engage with the material again.

In contrast, Internet-based courses can and should be constructed to require students to engage with the material every day (Newlin and Wang, 2002; Elvers et al., 2003). For example, in my Internet-based courses, students are required to log in almost daily and to complete multiple, small assignments each week (e.g., Foertsch and Gernsbacher, 2008; Gernsbacher, 2013). Furthermore, the assignments are constructed so that it is not in the students' best interest to mass their practice and attempt to do a week's worth of assignments in one sitting. Doing so would be akin to trying to do a week's worth of athletic workouts in one trip to the gym; trying to eat a week's worth of food in one sitting; trying to visit five European cities in 1 day. It simply would not be feasible.

Thus, Internet-based higher education enables students to distribute their learning over time, to engage with the material in short, frequent episodes, and to master the material in increments, rather than in once- or twice-a-week doses. These short, frequent, and distributed episodes of practice can lead to better mastery.

INTERNET-BASED HIGHER EDUCATION CAN OPTIMIZE PERFORMANCE

Psychological science, as well as personal observation, identifies differences among us in our optimal time of the day. Our cognitive processes peak at our optimal times and flounder at our non-optimal times (May and Hasher, 1998; May, 1999). Empirical research documents that every cognitive process – memory (West et al., 2002), attention (May, 1999), language comprehension (Natale and Lorenzetti, 1997), even intelligence testing

(Goldstein et al., 2007), and attitude change (Martin and Marrington, 2005) – operates at a peak during our optimal time of the day.

The older we get, the earlier in the day we find our peak time for performance (May et al., 1993), which might explain why, at least at my university, many professors like to teach at 8:00 AM. However, at 8:00 AM most traditional-age undergraduate students have barely gone through two full stages of REM sleep (Randall, 2012). Even if students have tried to get a good night of sleep, their biology dictates against morning hours bringing their optimal performance (American Academy of Pediatrics, 2014). Indeed, by puberty, students' optimal time of the day has already shifted beyond the traditional school day to evening (Kim et al., 2002).

The beauty of Internet-based higher education is that learners can engage with the material – and the course – at whatever time of the day or night works best for them. For example, in my Internet-based courses, all assignments are due at 11:59 PM, but students can complete the assignments hours or days before they are due. Students can also engage with the material around the clock (i.e., 24/7). Thus, Internet-based higher education can optimize performance by allowing students to capitalize on their own optimal time of the day.

INTERNET-BASED HIGHER EDUCATION CAN DEEPEN MEMORY

Psychological science documents the value of deeper levels of processing (Craik, 2010). Information that is processed to a deeper level is remembered better; more deeply processed information is also more tightly connected to previously learned and subsequently learned concepts. Internet-based learning can deepen levels of processing for one simple reason: To allay concerns about cheating, assignments and exams must assess deeper levels of processing.

One of the primary concerns that faculty have about Internet-based teaching is the worry that students will cheat (Parker et al., 2011). By cheat, instructors usually mean look up the answers. But if the answer to a question, or the solution to a problem, is just a click away – be the assignment Internet-based or in-person – that assignment is not assessing a very deep level of processing. We should probably not assess such superficial knowledge in our higher education courses.

Therefore, in my Internet-based courses, I expect students to take advantage of all the material the world wide web has to offer. I encourage students to click and scroll and open as many browser windows as they want when they are completing assignments, solving problems, and taking exams. If the answer to one of my test questions is just one click away, it is not a very good test question.

Similarly, if instructors hesitant-to-embrace Internet-based instruction are worried about their students enlisting a ringer to complete their assignments or take their tests, my response is the same: do not design assessments that anyone can simply parachute into – regardless of whether you are designing assessments that are Internet-based or in person. Valid assessments should assay mastery of the course material, for which active members of the course should be advantaged.

INTERNET-BASED HIGHER EDUCATION CAN PROMOTE CRITICAL THINKING

A few years ago, a group of psychology students at the University of Cincinnati refused to spend $168 to purchase the textbook for their course. Instead they gathered all the information they needed for their course using only the Internet. How did these students fare? Top of the class (Massis, 2013).

How could that be? Isn't the Internet is full of cat videos? Yes, it is (Clark, 2012). But the Internet is also full of 100s of videos that explain how to compute a *t*-test, which is a basic statistical tool for students and scholars. The videos available on YouTube and other Internet-based video sharing sites provide a vibrant component of many curricula, including health education (Akagia, 2008; Burke and Snyder, 2008), African American studies (White, 2009), anatomy (Jaffar, 2012), Shakespeare (Desmet, 2009), music instruction (Kruse and Veblen, 2012), American history (Rees, 2008), and nursing (Clifton and Mann, 2011).

Moreover, as research published in *Nature* demonstrated, information available on the Internet-based Wikipedia is just as accurate as information available in the print-based *Encyclopedia Britannica* (Giles, 2005). That is not to say that either Wikipedia or *Encyclopedia Britannica* is 100% accurate, but Wikipedia is no less accurate than a traditional print-based encyclopedia.

The accuracy of information on the Internet, although commonly underestimated, is one factor that led to the University of Cincinnati students' success with substituting Internet-based information for a standard textbook. The other factor was that the process of gathering information from the Internet evokes more critical thinking than simply reading a textbook. Active learning – winnowing and sifting intellectual wheat from chaff – facilitates learning (Tsui, 1999; Prince, 2004; Chi, 2009; Freeman et al., 2014). The Internet magnifies the opportunities for winnowing and sifting (Newlin and Wang, 2002; Weiler, 2004).

INTERNET-BASED HIGHER EDUCATION CAN ENHANCE WRITING SKILLS

After critical thinking skills, writing skills are what employees consistently rank as necessary in college graduates [Association of American Colleges and Universities and Hart Research Associates (AAC&U), 2013; Sternberg, 2013]. However, many college-level instructors rate their students' writing skills as only fair (Purcell et al., 2013). Internet-based higher education can enhance students' writing skills by capitalizing on the Internet's inherently text-based mode of communication (Gernsbacher, 2014) and the Internet's inherently broad-based audience (Ellison and Wu, 2008).

For example, across one term of my Internet-based courses, each student composes approximately 85 posts, with each post comprising two to three paragraphs. In essence, each student writes the equivalent of a five-page double-spaced paper each of 15 weeks. Text-based communication on the Internet is a feature, not a bug (Gernsbacher, 2014).

Who reads the equivalent of 50 students' five-page papers each week? I read a sample of them, but the primary readers are the other students in the class. Across the semester, each student reads and comments on over 700 posts written by their peers. Requiring this quantity of reading and writing in a face-to-face college course

would consume all the class meeting time. That is not a concern with Internet-based courses.

Moreover, as the Stanford Study of Writing attests (ssw.stanford.edu), today's Internet-native students are vastly more experienced writing for the public than we professors were at their age (Fishman et al., 2005). Many of today's college students have written blogs since they were 12 years old and posted Facebook statuses since they were 14; they might have commented on more Internet sites than most professors have read (Keller, 2009).

Therefore, today's students are "almost always less enthusiastic about their in-class writing because it ha(s) no audience but the professor" and it fails to "serve any purpose other than to get them a grade" (Thompson, 2009). Writing to an audience that comprises only the professor is not a concern with Internet-based courses. Posting on a discussion board is de rigueur in most all Internet-based courses, and attaching a document to a common discussion board for all class members to read is just as easy as emailing it to the professor.

Writing to a broad audience (an entire class or an entire Internet) rather than only the professor empirically improves technical aspects of composition (Day et al., 1998); encourages students to write longer and more often (Kaplan et al., 2007); and increases students' mastery of logical, ethical, and emotional appeal, as well as increasing their treatment of opposing views (Gaddis et al., 2000).

The Stanford Study of Writing also points to the fact that text-speak rarely if ever enters into students' course-based writing, an observation I, too, have made. In fact, writing for the Internet increases, rather than decreases, students' grammatical and syntactic skills (Gaddis et al., 2000).

IN SUM

This essay illustrates five reasons why Internet-based higher education can capitalize on principles of learning and, therefore, why Internet-based education can lead to effective pedagogy. Internet-based education can lead to better mastery by providing short, frequent episodes of practice rather than less frequent bouts of practice. Internet-based education can optimize performance by allowing students to engage with the material – and the course – at whatever time of the day works best for them.

Internet-based education can deepen memory by necessitating cheat-proof assignments and exams that engage deeper levels of processing. Internet-based education can promote critical thinking by empowering students to gather multiple sources of information and distinguish wheat from chaff. Lastly, Internet-based education can enhance writing skills by multiplying the writing opportunities with a built-in audience beyond the professor.

A recent meta-analysis by the U. S. Department of Education (2010) evaluated 50 high quality contrasts of Internet-based versus face-to-face courses. The results showed a consistent advantage in student learning from Internet-based higher education courses. However, the report cautioned that the "positive effects (of Internet-based learning) should not be attributed to the media, *per se*" (p. ix). Indeed, it is likely that any medium will lead to more successful pedagogy if it capitalizes on fundamental principles of learning.

REFERENCES

Akagia, C. (2008). YouTube? For health education? *Am. J. Health Educ.* 39, 58–60. doi: 10.1080/19325037.2008.10599015

Allen, I. E., and Seaman, J. (2014). *Grade Change: Tracking Online Education in the United States.* Wellesley, MA: Babson Survey Research Group and Quahog Research Group.

American Academy of Pediatrics. (2014). School start times for adolescents. *Pediatrics* 134, 642–649. doi: 10.1542/peds.2014-1697

Association of American Colleges and Universities and Hart Research Associates (AAC&U). (2013). *It Takes More than a Major: Employer Priorities for College Learning and Student Success.* Washington, DC: Association of American Colleges and Universities.

Benjamin, A. S., and Tullis, J. (2010). What makes distributed practice effective? *Cogn. Psychol.* 61, 228–247. doi: 10.1016/j.cogpsych.2010.05.004

Budé, L., Imbos, T., van de Wiel, M. W., and Berger, M. P. (2010). The effect of distributed practice on students' conceptual understanding of statistics. *Int. J. Higher Educ. Res.* 62, 69–79. doi: 10.1007/s10734-010-9366-y

Burke, S. C., and Snyder, S. L. (2008). YouTube: an innovative learning resource for college health education courses. *Int. Electronic J. Health Educ.* 11, 39–46.

Chi, M. T. H. (2009). Active-constructive-interactive: a conceptual framework for differentiating learning activities. *Top. Cogn. Sci.* 1, 73–105. doi: 10.1111/j.1756-8765.2008.01005.x

Clark, L. (2012). *Google's Artificial Brain Learns to Find Cat Videos*, Wired Magazine. Available at: http://www.wired.com/2012/06/google-x-neural-network

Clifton, A., and Mann, C. (2011). Can YouTube enhance student nurse learning? *Nurse Educ. Today* 31, 311–313. doi: 10.1016/j.nedt.2010.10.004

Craik, F. I. M. (2010). "Levels of processing in human memory," in *Psychology and the Real World: Essays Illustrating Fundamental Contributions to Society*, eds M. A. Gernsbacher, R. W. Pew, L. M., Hough, and J. R. Pomerantz (New York: Worth Publishers), 76–82.

Day, T. M., Raven, M. R., and Newman, M. E. (1998). The effects of world wide web instruction and traditional instruction and learning styles on achievement and changes in student attitudes in a technical writing in an agricommunication course. *J. Agric. Educ.* 39, 65–75. doi: 10.5032/jae.1998.04065

Desmet, C. (2009). Teaching Shakespeare with YouTube. *English J.* 99, 65–70.

Ellison, N. B., and Wu, Y. (2008). Blogging in the classroom: a preliminary exploration of student attitudes and impact on comprehension. *J. Educ. Multimed. Hypermed.* 17, 99–122.

Elvers, C., Polzella, D. J., and Graetz, K. (2003). Procrastination in online courses: performance and attitudinal differences. *Teach. Psychol.* 30, 159–162. doi: 10.1207/S15328023TOP3002_13

Fishman, J., Lunsford, L., McGregor, B., and Otuteye, M. (2005). Performing writing, performing literacy. *Coll. Compos. Commun.* 57, 224–252.

Foertsch, J., and Gernsbacher, M. A. (2008). When the medium illuminates the content: exploiting the unique features of online communication in an undergraduate psychology course. *Innovate* 4:3.

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., et al. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proc. Natl. Acad. Sci. U.S.A.* 111, 8410–8415. doi: 10.1073/pnas.1319030111

Gaddis, B., Napierkowski, H., Guzman, N., and Muth, R. (2000). *A Comparison of Collaborative Learning and Audience Awareness in Two Computer-Mediated Writing Environments.* Available at: http://eric.ed.gov/?id = ED455771

Gernsbacher, M. A. (2013). *Improving Scholarly Communication: an Online Course*, University of Wisconsin-Madison. Available at: http://www.gernsbacherlab.org/research/online-communication-research/online-courses

Gernsbacher, M. A. (2014). Internet-based communication. *Discourse Process.* 51, 359–373. doi: 10.1080/0163853X.2014.916174

Giles, J. (2005). Internet encyclopaedias go head to head. *Nature* 438, 900–901. doi: 10.1038/438900a

Goldstein, D., Hahn, C. S., Hasher, L., Wiprzycka, U. J., and Zelazo, P. D. (2007). Time of day, intellectual performance, and behavioral problems in morning versus evening type adolescents: is there a synchrony effect? *Personal. Individ. Dif.* 42, 431–440. doi: 10.1016/j.paid.2006.07.008

Holzinger, A., Kickmeier-Rust, M. D., and Ebner, M. (2009). "Interactive technology for enhancing distributed learning: a study on weblogs," in *proceeding of 23rd British HCI Group Annual Conference on People and Computers: Celebrating People and Technology* (Swinton: British Computer Society), 23, 309–312.

Jaffar, A. A. (2012). YouTube: an emerging tool in anatomy education. *Anat. Sci. Educ.* 5, 158–164. doi: 10.1002/ase.1268

Kaplan, D. S., Rupley, W. H., Sparks, J., and Holcomb, A. (2007). Comparing traditional journal writing with journal writing shared over e-mail list serves as tools for facilitating reflective thinking: a study of preservice teachers. *J. Lit. Res.* 39, 357–387. doi: 10.1080/10862960701613136

Keller, J. (2009). *Studies Explore Whether the Internet Makes Students Better Writers. The Chronicle of Higher Education.* Available at: http://chronicle.com/article/Studies-Explore-Whether-the/44476

Kellogg, R. T., and Raulerson, B. A. III. (2007). Improving the writing skills of college students. *Psychon. Bull. Rev.* 14, 237–242. doi: 10.3758/BF03194058

Kim, S., Dueker, G. L., Hasher, L., and Goldstein, D. (2002). Children's time of day preference: age, gender and ethnic differences. *Pers. Individ. Dif.* 33, 1083–1090. doi: 10.1016/S0191-8869(01)00214-8

Kruse, N. B., and Veblen, K. K. (2012). Music teaching and learning online: considering YouTube instructional videos. *J. Music Technol. Educ.* 5, 77–87 doi: 10.1386/jmte.5.1.77_1

Martin, P. Y., and Marrington, S. (2005). Morningness–eveningness orientation, optimal time-of-day and attitude change: evidence for the systematic processing of a persuasive communication. *Pers. Individ. Dif.* 39, 367–377. doi: 10.1016/j.paid.2005.01.021

Massis, B. E. (2013). Textbook affordability: the library's role. *New Library World* 114, 179–183. doi: 10.1108/03074801311304087

May, C. P. (1999). Synchrony effects in cognition: the costs and a benefit. *Psychon. Bull. Rev.* 6, 142–147. doi: 10.3758/BF03210822

May, C. P., and Hasher, L. (1998). Synchrony effects in inhibitory control over thought and action. *J. Exp. Psychol. Hum. Percept. Perform.* 24, 363–379. doi: 10.1037/0096-1523.24.2.363

May, C. P., Hasher, L., and Stoltzfus, E. R. (1993). Optimal time of day and the magnitude of age differences in memory. *Psychol. Sci.* 4, 326–330. doi: 10.1111/j.1467-9280.1993.tb00573.x

Natale, V., and Lorenzetti, R. (1997). Influences of morningness-eveningness and time of day on narrative comprehension. *Pers. Individ. Dif.* 23, 685–690. doi: 10.1016/S0191-8869(97)00059-7

Newlin, M. H., and Wang, A. Y. (2002). Integrating technology and pedagogy: web instruction and seven principles of undergraduate education. *Teach. Psychol.* 29, 325–330. doi: 10.1207/S15328023TOP2904_15

Oseas, L., and Underwood, B. J. (1952). Studies of distributed practice: v. Learning and retention of concepts. *J. Exp. Psychol.* 43, 143–148. doi: 10.1037/h0062903

Parker, K., Lenhart, A., and Moore, K. (2011). *The digital revolution and higher education. Pew Internet.* Available at: http://www.pewinternet.org/2011/08/28/the-digital-revolution-and-higher-education

Prince, M. (2004). Does active learning work? A review of the research. *J. Eng. Educ.* 93, 223–231. doi: 10.1002/j.2168-9830.2004.tb00809.x

Purcell, K., Buchanan, J., and Friedrich, L. (2013). *The Impact of Digital Tools on Student Writing and How Writing is Taught in Schools. PewResearch Internet Project.* Available at: http://www.pewinternet.org/2013/07/16/the-impact-of-digital-tools-on-student-writing-and-how-writing-is-taught-in-schools

Randall, D. K. (2012). *Dreamland: Adventures in the Strange Science of Sleep.* New York: W. W. Norton & Company.

Rees, J. (2008). *Teaching History with YouTube (and other Primary-Source Video Sites on the Internet). Perspectives on History.* Available at: http://www.historians.org/publications-and-directories/perspectives-on-history/may-2008/teaching-history-with-youtube

Reynolds, J. H., and Glaser, R. (1964). Effects of repetition and spaced review upon retention of a complex learning task. *J. Educ. Psychol.* 55, 297–308. doi: 10.1037/h0040734

Roediger, H. L. III., and Pyc, M. A. (2012). Inexpensive techniques to improve education: applying cognitive psychology to enhance educational practice. *J. Appl. Res. Mem. Cogn.* 1, 242–248. doi: 10.1016/j.jarmac.2012.09.002

Ruch, T. C. (1928). Factors influencing the relative economy of massed and distributed practice in learning. *Psychol. Rev.* 35, 19–45. doi: 10.1037/h0074423

Seabrook, R., Brown, G. D. A., and Solity, J. E. (2005). Distributed and massed practice: from laboratory to classroom. *Appl. Cogn. Psychol.* 19, 107–122. doi: 10.1002/acp.1066

Selingo, J. (2013). *College Unbound: The Future of Higher Education and What it Means for Students.* New York: New Harvest.

Sternberg, R. J. (2013). *Giving Employers What they Don't Really Want. The Chronicle of Higher Education.* Available at: http://chronicle.com/article/Giving-Employers-What-They/139877

Thompson, C. (2009). *Clive Thompson on the New Literacy*, Wired Magazine. Available at: http://archive.wired.com/techbiz/people/magazine/17-09/st_thompson

Tsui, L. (1999). Courses and instruction affecting critical thinking. *Res. High. Educ.* 40, 185–200. doi: 10.1023/A:1018734630124

U. S. Department of Education. (2010). *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies.* Washington, DC: Office of Planning, Evaluation, and Policy Development.

Underwood, B. J. (1961). Ten years of massed practice on distributed practice. *Psychol. Rev.* 68, 229–247. doi: 10.1037/h0047516

Weiler, A. (2004). Information-seeking behavior in Generation Y students: motivation, critical thinking, and learning theory. *J. Acad. Librariansh.* 31, 46–53. doi: 10.1016/j.acalib.2004.09.009

West, R., Murphy, K. J., Armilio, M. L., Craik, F. I. M., and Stuss, D. T. (2002). Effects of time of day on age differences in working memory. *J. Gerontol.* 57B, 3–10. doi: 10.1093/geronb/57.1.P3

White, E. J. (2009). Coffy, YouTube, and Uncle Ben: the use of film and new media in the teaching of African American Studies at the University of Hawai'i. *New Media Higher Educ.* 42, 47–53.

Willingham, D. T. (2002). Ask the Cognitive Scientist. Allocating student study time: "Massed" versus "Distributed" practice. *Am. Educ.* 26, 37–39.

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The quest for knowledge transfer efficacy: blended teaching, online and in-class, with consideration of learning typologies for non-traditional and traditional students

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The pedagogical paradigm shift in higher education to 24-h learning environments composed of teaching delivery methods of online courses, blended/hybrid formats, and face-to-face (f2f) classes is increasing access to global, lifelong learning. Online degrees have been offered at 62.4% of 2800 colleges and universities. Students can now design flexible, life-balanced course schedules. Higher knowledge transfer rates may exist with blended course formats with online quizzes and valuable class time set for Socratic, quality discussions and creative team presentations. Research indicates that younger, traditional students exhibit heightened performance goal orientations and prefer entertaining professors who are funny, whereas non-traditional students exhibit mastery profiles and prefer courses taught by flexible, yet organized, professors. A 5-year study found that amongst 51,000 students taking both f2f and online courses, higher online failure rates occurred. Competing life roles for non-traditional students and reading and writing needs for at-risk students suggest that performance may be better if programs are started in f2f courses. Models on effective knowledge transfer consider the planning process, delivery methods, and workplace application, but a gap exists for identifying the diversity of learner needs. Higher education enrollments are being compromised with lower online retention rates. Therefore, the main purpose of this review is to delineate disparate learning styles and present a typology for the learning needs of traditional and non-traditional students. Secondly, psychology as a science may need more rigorous curriculum markers like mapping APA guidelines to knowledge objectives, critical assignments, and student learning outcomes (SLOs) (e.g., online rubric assessments for scoring APA style critical thinking essays on selected *New York Times* books). Efficacious knowledge transfer to diverse, 21st century students should be the Academy's focus.

Keywords: blended/hybrid courses, online courses, face-to-face (f2f) courses, learning needs typology, non-traditional students, traditional students, knowledge transfer, student learning outcomes SLOs

INTRODUCTION

The pedagogical paradigm shift in higher education to 24-h learning environments, encompassing several delivery formats including online courses, blended/hybrid designed courses, and the traditional face-to-face (f2f) lecture classes have increased student access and engagement into global, lifelong learning. The Babson Survey Research Group, in a 10-year study, found that fully online degrees have been offered at 62.4% of the 2800 colleges and universities surveyed and the results indicated an increase of over 6.7 million students taking at least one online course during Fall of 2011 (Allen and Seaman, 2013; Estes, 2013). Teaching pedagogy is dramatically changing within today's challenging educational environments, composed of diverse traditional, and non-traditional student populations. Many educators are experiencing the benefits of greater flexibility in course design and in delivery methods by building courses with technology infused tools. The traditional pedagogical lecture method of f2f delivery, with all content delivered in the classroom, transforms into a web-facilitated course when technology tools like course management systems (CMS) and teacher designed web pages are used to enhance teaching delivery. Asynchronous online courses are now considered the most common delivery format, although teacher and student feedback is delayed. Another teaching style includes the blended/hybrid course format consisting of combinations of f2f teaching, synchronized (real time feedback), and asynchronous online delivery (Dunn et al., 2011b). Also, there is the "flipped" type model where students watch taped lectures outside of classroom time. Lifelong learning is being promoted through continuing education programs to attract new students and improve retention with a goal of widening participation across diverse populations (Roberts, 2011; Caffarella and Daffron, 2013). Free massive open online courses (MOOCs) are being offered at prestigious universities, with completion certificates offered at 2.6% of universities, and they are part of strategic plans in another 9.4% (Allen and Seaman, 2013; Christensen and Horn, 2013; Phillips, 2013). However, a University of Pennsylvania

research study found a completion rate of only 4% with MOOCs (Lewin, 2013).

Present research is painting a mixed portrait of student performance and their university experience that varies across pedagogical delivery methods. Prior research by Daffron and North (2011) has indicated the need of the Academy to focus on the efficacy of successful knowledge transfer. In their Transfer of Learning Model, seven variables are considered including (1) the planning process, (2) learner characteristics and motivation (3) design and delivery methods, (4) learning context, (5) immediate application, (6) workplace environment, and (7) eliminating barriers (Daffron and North, 2011; Caffarella and Daffron, 2013). While this model addresses transfer process influencers and planning processes, a gap still exists for identifying the diversity of learner needs. Higher education administrators are finding that enrollments are being compromised with lower online retention rates and subpar student performance. Educational administrators may overly focus on per student cost approaches to education vs. focusing on performance outcomes and learner needs matched to delivery methods and educator abilities. Therefore, the main purpose of this research review is to delineate disparate learning styles and present a typology for the different learning needs of traditional and non-traditional students in higher education.

Foremost, typical university student populations have dramatically changed and are now composed of differences in demographic characteristics, socio economic status (SES), part-time and/or full-time student workers, and military cohorts. The traditional student (ages 18–21 years) generally works part-time, attends day classes, and participates in the university social experience; whereas an emerging "new student" cohort is the non-traditional, adult student (ages 22–55+ years) who works more full-time, juggles family responsibilities, and attends more night courses (Munro, 2011). Additionally, we propose that psychology as a science and other social science disciplines may need to update, to improve scholarship in teaching and performance outcomes, and to consider developing more rigorous assessments within faculty-approved curricula (American Psychological Association, 2007, 2013; Buskist et al., 2008).

Clearly, it is beneficial for students to have the flexibility of at least some online course delivery for their degree program. However, research on the learning efficacy of different delivery methods is starting to reveal some associated complexities, including lower retention rates, and maybe lower levels of content mastery. Alarming university dropout rates, coupled with the need for student retention, has led to research evidence suggesting that different student profiles do exist, and maybe these student cohorts have culturally different ways of learning. Columbia University's Community College Research Center conducted a 5-year study and found that among 51,000 students taking both f2f and online courses, higher failure rates occurred with the students who took online courses. Also, lab-based social science courses, including psychology, were rated as more difficult for students to take online. Non-traditional students, with competing life roles and at times considered at-risk students who have higher needs for reading and writing instruction, may perform better in high fidelity, traditional f2f courses (New York Times - Editorial, 2013; Xu and Jaggars, 2013). Students who need basic math and English skills may need more guidance from their teachers, using a scaffolding learning approach (Vygotsky, 1978). Furthermore, Xu and Jaggars (2013) found significant discontinuities in online learning between different demographic groups and suggest four solutions: (1) delay online courses for screened, at-risk individuals, (2) start learning support approaches like scaffolding, (3) use online warning systems for low performance (e.g., Starfish), and (4) pedagogical focus on building quality online courses. Although there is an exciting growth of global MOOCs and other fully online course programs, there seems to be research gaps on measuring student behavior, performance, and motivation while taking online courses, along with measuring their persistence in completing courses, and content mastery within the social science disciplines.

Educational researchers need to refocus on the different pedagogical models being experienced and driven by a surge of technology-based online classes. Not only do students have greater flexibility in designing program schedules with f2f and/or online learning environments, but also differences in traditional and non-traditional learning styles and needs challenge teachers to adapt their teaching methodology. Many non-traditional, working students describe "ideal" professors as flexible and organized; whereas, traditional students describe them as funny and enthusiastic (Rosenthal et al., 2000; Strage, 2008). Learning styles differ such that the profiles of mature, non-traditional students who transfer from community colleges to universities exhibit more performance mastery of content, while younger traditional students show more performance-goal orientations (Dweck, 1999; Hoyert and O'Dell, 2009). Non-traditional students tend to value more educational, lifelong learning goals, and are mindful of the potential socio-economic benefits associated with higher learning; whereas, younger, traditional students are more reflection-oriented about their educational experience and focus on the performance of making high grades (Jinkens, 2009). In order to address the research disparity and clarify learner differences, this literature review and proposed typology is guided by category questions that delineate the disparate learning styles of traditional from non-traditional students in hopes for higher academic performance and residual, retention goals. Our literature research review is guided by seven categories that address different traditional and non-traditional student needs and are as follows:

1. What are the different learning needs?
2. What institutional support is needed?
3. What are the computer technology needs?
4. What are the educational culture and social needs?
5. What faculty-matched abilities are needed?
6. What learning styles (auditory, visual, and/or kinesthetic) are needed?
7. What is needed for different course subjects?

Through these directed research questions and supporting research evidence, the main purpose of the review is to delineate disparate learning styles and present a distinct student learning needs typology, created as a working reference, for traditional and

non-traditional student cohorts across course delivery formats. Secondly, we propose that higher knowledge transfer efficacy may be achieved in support of psychology as a science through building more rigorous curriculum markers like mapping APA guidelines to knowledge objectives, critical assignments, and student learning outcomes (SLOs). Thirdly, we review learner needs across the course delivery methods of f2f, blended/hybrid, and fully online formats. The hope is that administrators and educators may be able to increase student performance and retention rates by matching teaching delivery methods to the disparate learning needs of the 21st century university students.

NON-TRADITIONAL AND TRADITIONAL STUDENT LEARNING STYLES

Many researchers in teaching pedagogy have focused their studies on the academic needs of the traditionally perceived student (ages 18–21 years) who usually attends daytime courses in college classrooms, does extensive library study, and stays to participate in social activities on university campuses (Munro, 2011). Another growing academic student cohort is composed of the non-traditional, adult student-workers (22–55+ years of age) who usually attend more night time classes at satellite campuses, and balance more competing life roles including family, elderly care, and multiple part-time to full-time jobs along with their academic schedules. International and respective American literature define non-traditional students at the undergraduate and graduate levels as (1) individuals who enter school several years later after high school at 23 or 25 years old and may need preparatory math or English reentry courses, (2) minority students from different ethnic backgrounds with lower socio-economic status and/or (3) individuals who may have risk factors for dropping out of school including full-time employment, multiple family role responsibilities, and single parenthood (Kim and Bonk, 2006; Miller and Hudson, 2007; Gilardi, 2011; Xu and Jaggars, 2013). A Pew Research Center study found African Americans Internet use is 80% compared to the 87% use by whites indicating a 7% gap in technology access (Smith, 2014). Also, 73% of African Americans who use the Internet also use social networking platforms, like Twitter and Facebook. Although, the research revealed that 92% of African Americans do own cell phones of which 56% are smartphones, giving this cohort potentially equal access to courses through the use of their mobile platforms. Therefore, universities need to make sure computer labs are available with day and night hour access especially for non-traditional students.

Recent studies are addressing non-traditional student time management, stress and coping factors (Forbus et al., 2011), and their attitudes and performance with online distance learning (Beaghan, 2013). Research from Australia, the United Kingdom, and the United States on how the non-traditional student-worker, or emerging "new student" in UK literature, faces academic challenges which include performing quality academic work and fitting into the university environment (Munro, 2011). Research evidence suggests that only a minority of Australian working-class individuals, who had been exposed to fewer opportunities and more educational exclusions, were able to gain a university education (Pearce et al., 2008). This research found three themes existed for the educational success of non-traditional students including (1) self-discovery joy of the world, (2) a mission or quest to make the world a better place, and (3) a chance to make better lives for themselves and their children. The qualitative narrative research of Pearce et al. (2008) found that successful non-traditional students were persistent and would not give up on fitting in and attaining a higher education. Furthermore, these researchers advocate "second chance" programs for the "unfinished business of schooling."

Gilardi (2011) researched students of Political Science across the northern Italian public university system and found that non-traditional students focus more on the learning experience and do have more difficulties as compared to traditional students in navigating the university system the first year. Also, Italian and USA literature reviews supported some of these differences between traditional and non-traditional students such that traditional students have a greater need for learning context and meaningfulness associated with the university experience. On the other hand, evidence found that non-traditional students need traditional in classroom experiences and value their education as part of professional development. This career development focus helps them connect their own professional life experiences to learned theory, and decipher many implications on an applied level (Gilardi, 2011). Van Doorn and Chesterman (2012) suggest that non-traditional students "raise the bar academically" through their wisdom gained from life experiences and transfer this vicarious benefit to traditional students through collaborative group work in class. Also, the traditional students bring their youthful enthusiasm and knowledge of current social and cultural trends to classroom sharing, in turn, benefiting non-traditional students. However, it is a noteworthy fact that only a minority of students has access to living on college campuses (Christensen and Horn, 2013).

United States community colleges serve half of all undergraduate students with over 6.5 million enrolled in 2005. Community College serve 68% white students, 27% black, non-Hispanic, 1% Hispanic, 1% American Indian, 1% Asian-Pacific Islander, and others (American Association of Community Colleges, 2014). International student enrollments in American colleges for fall 2009 increased by 3% and were mostly represented by students from China, India, the Middle East, and Africa (Fischer, 2010). Hermida (2010) expands the non-traditional student definition by including recent immigrants, internationals, and first-generation students and challenges the North American pedagogy as less integrative of the culture, diversity, and values of non-traditional students. Furthermore, this research evidence suggests offering a pedagogical strategy of "inclusive teaching" with diverse knowledge modes and the use of the expressive story-telling style. Therefore, the entire student classroom gains in heightened diversity perspectives from this story-telling technique that demonstrates peer cultural differences (Reevy, 2012). In class storytelling fits better with in class delivery, but also could be adapted through video taping student stories to upload in the online class. Additionally, traditional students tend to value organizational support when integrating into a university and represent 60% of the student population; whereas, the other 40% composed of non-traditional students value the overall academic environment for their university commitment (Wardley et al., 2013).

There are several key differences between the learning styles and needs typology of traditional vs. non-traditional students. Firstly, traditional students are more ready to enter university with more confidence usually due to working less than 40 h in part-time employment and by having considerably fewer family responsibilities to interfere with academic studies. On the other hand, many years may have passed since the non-traditional student was last in a formal learning environment and may need to build personal confidence and motivation to not only return, but also to persist within the educational culture. Also, non-traditional students may have very full daily schedules and, thereby, experience time management constraints and fatigue issues. Late night course offerings, whether f2f or online, may be the best options for non-traditional students. Evening courses may be best delivered through a mix of teaching methods of lecture, video, group work, and role-play in order to keep a lively, upbeat discussion that fully engages students who have just arrived from a full day of work. In addition, institutional integration and social connections may be met by club memberships (e.g., Psi Lambda psychology club, Psi Chi International Honor Society, Pi Sigma Alpha). Outside-the-classroom learning opportunities may involve service-learning opportunities like community volunteerism, charity fundraising, applied work internships, and job networking. Most traditional students prefer the university social experience of sororities and fraternities; whereas non-traditional students who are achievement-oriented have less daytime available for social events.

This brings us to a discussion of how to best address the very different needs and learning styles of traditional vs. non-traditional undergraduate and graduate students. We suggest that research is revealing distinct learning style differences in these student cohorts. Mapping pedagogical delivery formats and university support services to these distinct need differences may enhance overall student educational experiences for improved retention and learning mastery. Our typology, as shown in **Table 1**, for traditional and non-traditional student learning needs are categorized into seven sections including for (A) learning needs (B) institutional support, (C) computer technology, (D) educational culture, and social needs, (E) faculty-matched abilities, (F) learning style considerations, and (G) course subject needs. The student needs are compared between traditional and non-traditional needs based on research findings and matched by number. For example, the learning need for traditional students includes (1) an entertainment-style of teaching with maximum in-class time and personal contact with enthusiastic instructors; whereas, non-traditional students prefer (1) organized classroom structures with some online instruction (Hoyert and O'Dell, 2009). See **Table 1** for the complete typology of parallel comparisons between traditional and non-traditional student learning styles and needs.

KNOWLEDGE TRANSFER STRATEGIES AND LEARNING STYLES

Research indicates that individuals learn differently through their physical senses of visual and auditory modalities and the tactile touch sense of kinesthetic learning. Educators who match their teaching methods to visual, auditory, and kinesthetic learners will enhance their students' knowledge transfer processes (DeBoth and Dominowski, 1978; Korenman and Peynircioglu, 2007; Weiermann, 2012). Research on comparing the efficacy of online training vs. f2f reveals that both increase social capital, but that the computer supported collaborative students had gained more group observation skills (Mebane et al., 2008). Research evidence indicates that the dynamic between instructor expertise and social richness of an in class environment enhances student enjoyment (Nemanich et al., 2009). In class course enjoyment was positively related to learning performance, but not online. In contrast, student's ability was positively related to online performance.

Educators may need to systematically teach cognitive methods to train learning skills with students, especially for non-traditional students in need of relearning study techniques. Robust cognitive learning strategies including mnemonics (Lorayne and Lucas, 1974), visual imagery, and word associations, (Shepard, 1967; Atkinson and Shiffrin, 1968; Paivio, 1969, 2008; Reed, 2013) and self-regulation learning strategies of forethought, performance, and self-reflection help with learning. Computer training can build technology self-efficacy to aid in online learning (Murray, 2000; Sitzmann, 2011; Wang et al., 2013). Support services including writing labs and math tutor services are value-added learning centers that may assist at risk students and non-traditional students in need of writing practice. These learning strategies have been found to enhance student performance and cognitive learning in the academic environment.

Traditional students are considered "*digital natives*" who have grown up in the global information age using computers to listen to music and to communicate (American Psychological Association, 2013). Technology-savvy students increase the demand for faculty to enhance their science of learning delivery to students as recommended by Principle 2, number 8 of the APA *Principles for Quality Undergraduate Education in Psychology* (American Psychological Association, 2013). Faculty-led curriculum steering committees could design web-facilitated, common assignments as course supplements that are posted within online core course shells. These common assignments can be mapped to the disciplinary APA guidelines for the undergraduate psychology major (American Psychological Association, 2007, 2013; Undergraduate Psychology Curriculum Committee, 2013) and to student knowledge objectives, critical thinking skills, and course learning outcomes. See **Figure 1** for an example mapping of an undergraduate psychology curriculum committee (UPCC) list of SLOs mapped to APA guidelines and principles (American Psychological Association, 2007, 2013; Undergraduate Psychology Curriculum Committee, 2013). For example, faculty may incorporate rubric-based, online programs like Livetext (www.livetext.com) and/or use CMSs like Blackboard for students to upload critical thinking essays written on selected *New York Times* best-seller books as common readers. With this type of assignment faculty can evaluate student mastery of APA style writing which may improve SLOs, while also providing assessment data evidence for university accreditation purposes. See **Figures 2**, **3** for an example of an online Livetext assignment with a grading rubric attached (Undergraduate Psychology Curriculum Committee, 2013). Suggestions for common readers and selected by the UPCC included *Blink: The Power of Think without Thinking* (Gladwell,

Table 1 | Typology of traditional and non-traditional student learning styles and needs.

Traditional undergraduate students *(* Graduate student needs)*	**Non-traditional undergraduate students** *(* Graduate student needs)*
LEARNING NEEDS	
Prefer entertainment style of teaching, maximum in-class time, and personal contact with enthusiastic teachers (Rosenthal et al., 2000; Hoyert and O'Dell, 2009)	Prefer flexible, yet organized teachers and organized classroom structures Rosenthal et al., 2000; Hoyert and O'Dell, 2009
Performance goal-oriented Hoyert and O'Dell, 2009	Subject mastery-oriented Hoyert and O'Dell, 2009
Changing needs for program course flexibility (e.g., use of video media like Youtube.com for assignments, interactive blogs, and social networks)	Availability and greater use of support services for learning Gilardi, 2011
Share cultural and current trends in class Van Doorn and Chesterman, 2012	Share work experience wisdom and diversity differences in class Van Doorn and Chesterman, 2012
Participate in Inclusive Teaching like story telling techniques to facilitate learning with non-traditional peers Hermida, 2010; Reevy, 2012	Participate in Inclusive Teaching like cultural story telling techniques to learn difficult concepts and connect with traditional students Hermida, 2010; Reevy, 2012
High participation in activities in the classroom to reduce attrition and improve attendance Gilardi, 2011 (e.g., sorority and fraternity membership, campus service clubs)	Lively discussions and group work in class due to full-time work stress and fatigue Forbus et al., 2011
"*Digital natives*" with need for use of all technology and social media platforms American Psychological Association, 2013	*Novices or "luddites" in need of technology training and use of course delivery formats Dunn et al., 2011a,b
*High need for program course flexibility to fit part-time work schedules: F2f, online, web facilitated, and blended/hybrid courses	*High need for program course flexibility to fit full-time work schedules: F2f, online, web facilities, and blended/hybrid courses
*In-person access to large on-campus and online research library, archives, databases, research laboratories, and search engines (e.g., Surveymonkey.com, Qualtrics.com)	*Access to online research library databases Some access to research search engines (e.g., Surveymonkey.com, Qualtrics.com)
Prefer online courses and some f2f courses with opportunities for supplemental on-line discussions (web facilitated and blended/hybrid formats)	Prefer f2f courses with some opportunities for supplemental on-line discussion (web facilitated and blended/hybrid formats)
*Learning models that incorporate more diversity American Psychological Association, 2013	*Learning models that incorporate more diversity American Psychological Association, 2013
*Maximum working time with supervisor during open laboratory hours	*Limited time with research supervisor during planned office hours
*National and International Conference research presentation needs	*Regional conferences for convenience—research presentation opportunities
*On campus research assistantships, work internships, and/or volunteerism for applied learning	*Off campus part-time internships, research assistantships, and/or volunteerism for applied learning
INSTITUTIONAL SUPPORT NEEDS	
University learning experience need with meaningfulness, resulting in higher retention Gilardi, 2011	University integration and relationship building with faculty, may result in higher retention (Gilardi, 2011)
Organized advising and program evaluation at key times including first semester planning, mid-program, and senior graduation year Kirp, 2014	More institutional, faculty, and advisor support for learning and social integration throughout degree program (Most et al., 2013; Beck and Milligan, 2014)
University support for self-discovery; campus activities and events for quick social integration Pearce et al., 2008	"Second chance"—the unfinished business of school programs to improve life chances and confidence building Pearce et al., 2008
Graduate school planning and career placement needs	Career placement and professional transition needs Some graduate school planning needs
COMPUTER TECHNOLOGY NEEDS	
More daytime computer lab and social media access while on campus Smith, 2014	More nighttime computer lab access—preferably 24-h computer labs Smith, 2014
BYOD, bring your own device; connection outlets for use of personal technology on campus Smith, 2014	Technology access to iPads, eReaders, and mobile platforms and use of Smartphones Smith, 2014
EDUCATIONAL CULTURE AND SOCIAL NEEDS	
First year integration into educational culture through student organizations (Reay et al., 2010; Munro, 2011; Kirp, 2014)	"Fitting in" educational culture and confidence building (Reay et al., 2010; Munro, 2011; Kirp, 2014)
Student identification, but appreciation building for the non-traditional student cohort Gilardi, 2011	Need for social opportunities, yet flexibility to lower attrition rates Gilardi, 2011 (e.g., service learning activities, club opportunities)
"Fitting in" and learning to become a critical thinker Munro, 2011	Reclassification as the emerging "new student" Munro, 2011
*Study Abroad—long term stay; global learning opportunities American Psychological Association, 2013	*Study Abroad—short term stay; global learning opportunities American Psychological Association, 2013

(Continued)

Table 1 | Continued

Traditional undergraduate students *(* Graduate student needs)*	**Non-traditional undergraduate students** *(* Graduate student needs)*
FACULTY MATCHED ABILITIES	
Social Media trained instructors (Smith, 2014); Online course training Quality Matters Program, 2011	Faculty with professional work experience; Online course training Quality Matters Program, 2011
Entertaining lecture style Hoyert and O'Dell, 2009	Faculty adept at in class pragmatic learning techniques Nemanich et al., 2009
Faculty knowledge of diverse student populations American Psychological Association, 2013	Faculty knowledge of diverse student populations American Psychological Association, 2013
Mentoring and advising duties	Mentoring and advising duties
Faculty knowledge of cognitive memory styles Sternberg and Grigorenko, 1997 for *training* students on study skills	Faculty knowledge of cognitive memory styles Sternberg and Grigorenko, 1997 for *relearning* of study techniques
Visual Imagery and word associations (Shepard, 1967; Paivio, 1969; Reed, 2013)	Visual Imagery and word associations (Shepard, 1967; Paivio, 1969; Reed, 2013)
Mnemonics Lorayne and Lucas, 1974	Mnemonics Lorayne and Lucas, 1974
Training students on Goal-setting theory and task motivation; rebuilding student self-efficacy Locke and Latham, 2002; Bandura and Locke, 2003	*Retraining* students on Goal-setting theory and task motivation; rebuilding student self-efficacy Locke and Latham, 2002; Bandura and Locke, 2003
	Use of scaffolding learning techniques Vygotsky, 1978
LEARNING STYLES: (VISUAL, AUDITORY, AND TACTILE/KINESTHETIC; Daffron and North, 2011)	
Visual Learning: use of visual videos, lectures, teamwork	Mixed methods used in class: videos, written assignments, lectures, group work
Auditory learning: taped online lectures for "flipped" and online	In class experiential and kinesthetic Style demonstrations; blended/hybrid facilitated
Kinesthetic learning: visits to museums, environmental learning, and space centers	Auditory learning through online voice-over lectures Weiermann, 2012
COURSE SUBJECT NEEDS: (PRELIMINARY LIST)	
Math—group study sessions for math problem practice	Math—offer in class courses with available math tutors
English—experiential learning (attend plays)	English—access to writing labs
Psychology—access to *research labs	Psychology—relate material to practical work world; in class or online labs
International relations—model United Nations participation.	International relations—*simulations with experiential learning and scenario-based case studies
Business—entrepreneurial projects; organizational field studies	Business—pragmatic case studies

2004) and *The Noticer: Sometimes, all a person needs is a little perspective* (Andrews, 2009).

As university administrators feel the competitive pull from fully online educational institutions, strategies for providing best practices and methods in teaching are being reviewed and updated, especially with the revealing low retention and completion rates found for online learning with MOOCs (Lewin, 2013). Some online-only educational providers have been criticized for less rigorous programs by offering courses that are not accredited. The U.S. Department of Education lists all accredited programs (U.S. Department of Education, 2014). Students who attend unaccredited colleges may compromise education quality and their careers when they face employers who may deny their degrees, find credits are nontransferable to accredited institutions, and have less access to government loans (Cooper, 2014). Universities are confronted with what makes them unique, academically rigorous, accredited, and thus more valuable to students as they increasingly move to online courses. This dilemma is captured in Doonesbury comic strips (Trudeau, 2011) where students float in cyberspace between interchangeable online schools at http://www.gocomics.com/doonesbury/2011/07/17. On another note, an institution's educational face validity—portrayal of student investment in quality learning—needs to match the rigor of accredited degree programs experienced by students. Furthermore, educational institutions may need heightened consideration of the importance of the experiential value of being a campus student and the social support functions associated with university membership for adult learners (Lundberg et al., 2008). With the typology of traditional and non-traditional student learning needs compared and curriculum rigor considerations, the delivery modalities need to be clearly reviewed and discussed for the teaching nuances found in each format of f2f, blended/hybrid, and fully online course. A brief review will follow in the next sections identifying key differences between the delivery methods.

TEACHING STYLES

TRADITIONAL FACE-TO-FACE FORMAT

Classic teaching guidance for newly minted teachers emphasized the need to transform how students observe world environments—a social constructivism approach. This approach uses the processes of perception, analyses, and expression found

*Potential mapping of APA (2013) principles.

Upon completion a student will be competent in the following areas:

1) Integrate information learned in previous course work in preparation for the Major Field Test in Psychology. (MFT will be fully integrated into Advanced General Psychology by the AY 2014–2015).
2) Survey original works in psychology and read empirical material. [APA, 2007; 1.2; 1.3; 2.2; 2.3; 2.5; 2.6, 3.1].
3) Analyze and discuss contemporary issues in psychology. [APA, 2007; 3.1, 3.2, 3.3].
4) Demonstrate skills in locating and reviewing relevant literature. [APA, 2007; 6.1; 6.2; 6.4].
5) Discuss various career paths in psychology and the requirements for them. [APA, 2007; 10; *APA, 2013].
6) Demonstrate the ability to recognize bias, discrimination, and stereotyping (Common reader assignment IAT tests). [APA, 2007; 1.3; 3.1; 3.2; 3.3; 3.4; 6.2; 6.3; 6.4; 7.2; 8.3; 8.5; 8.6].
7) Compare psychological perspectives with contemporary books read, such as the *common reader* book. [APA, 2007; 3.1; 3.2; 3.3; 6.1c (4); 7.1; *APA, 2013, 3.3].
8) Explain scientific evidence related to psychological perspectives. [APA Critical Thinking skills, APA, 2007; 3; 3.2; 3.3; 4.1; *APA, 2013, 3.3].
9) Demonstrate effective APA style, writing skills, and grammar. [APA, 2007; 6.2; 6.3; 6.4; 7.1; *APA, 2013; 1.5; 3.4; 5.1].
10) Demonstrate the ability to critically examine own behavior and attitudes regarding diversity and discuss these in relation to assigned reading material [*APA, 2013; Principles 1.3; 3.2].

FIGURE 1 | Example of student learning objectives for senior seminar course with mapping to APA guidelines (American Psychological Association, 2007, 2013; Undergraduate Psychology Curriculum Committee, 2013). *Adapted mapping of American Psychological Association (2013) principles. *Potential mapping of American Psychological Association (2013) principles.

in classroom debates where students critique and analyze the issues with their peers by engaging in discussions, laboratory sessions, collaborative learning, and field trips (Vygotsky, 1978; Wilkinson, 1984; Brufee, 1999). The art of teaching and classroom dynamics are rapidly changing with new technology-enhanced learning tools (Dunn et al., 2011a,b). Traditional f2f courses are defined as in class courses where content is taught in the classroom without any online technology, and course work is completed through writing assignments, exams, and homework (Allen and Seaman, 2013). Talented educators tend to elucidate core concepts, clearly articulate expectations, and transfer enthusiasm for the subject in a brief, efficient, and high fidelity manner. Within traditional f2f classrooms, a majority of students can have their questions answered instantly all at once vs. the delayed response times on asynchronous online courses.

The nuances of communication in facial expressions between students, peers, and instructors are part of the in class learning process for building relationships, career networking, and enhancing social and emotional intelligence (Goleman, 1995; Kristjα nsson, 2006). The classroom is a high fidelity learning environment where individual kinesthetic senses and perceptions are heightened. Instructors and students can actively conduct role-plays, student presentations, debates, and round-robin discussions (Van Doorn et al., 2012). Round-robin discussions involve taking a key idea and passing it along to another group to elaborate finer points. Here students invoke their personal style of voice and culture through communication, interpretation, and presentation skills. Additionally, teachers may find f2f learning provides unmatched learning opportunities enhanced with student participation in fun, exciting learning exercises like Jeopardy! Quiz Games and the use of Clickers (Personal Response systems) for instant feedback (e.g., polling and concept development). Jensen (2011) found students like the convenience of online video lectures, but prefer attending traditional lectures suggesting they have more focused attention in class. Classic psychology experiments may be remembered better if performed as demonstrations and as hands-on laboratory work. Research by Chen et al. (2009) found evidence that nuanced lessons conducted outside increased naturalist intelligence of students (Chen et al., 2009). Student/teacher and mentor relationships may be formed with direct access to professors for advisement and out-of-class (OCC) communication (Dunn et al., 2011a,b). Advisors can and do counsel students on course selection in order to design balanced schedules of in class and online courses that better fit busy life styles. And, f2f advising helps monitor students and their program evaluation progress for successful course completion to

REQUIRED ASSIGNMENTS. Please note that instructors may add more assignments as they desire, but for the pilot years of 2012–2014, instructors must include the following two Common Reader assignments in their syllabus and use *LiveText.com* for assessment:

A. *Common Reader* **Assignment 1:** (see assessment rubric attached)

The first assignment includes an Implicit Association Test that addresses biases and discrimination. Also, students need to include a discussion of stereotyping.

1. Students will access https://implicit.harvard.edu/implicit/demo/takeatest.html and select 3 IAT tests and print the results (Students need to show evidence of taking the tests).

2. Students will write a two page (500 words minimum) reflective essay.

a. Discuss what you learned from the IAT completion.

b. Relate the biases, discrimination, and stereotyping concepts learned to the *Common Reader* book.

c. Explain how you can use what you have learned.

B. *Common Reader* **Assignment 2:** Seniors students should have a good view of the different psychological perspectives and top psychologists in the fields: Psychodynamic, behaviorist, humanistic, cognitive, biopsychology-neuroscience, social and cultural, industrial/organizational, and evolutionary.

1. Students will select one perspective and relate it to the *new common reader* book.

2. Students will write a 3–4 pages APA style review (plus title and reference pages; 750 words minimum)

a. Discuss one perspective with supportive scientific, theory-based evidence.

b. Explain how it is related to the *common reader* book.

c. Relate the psychological perspective to your own views.

FIGURE 2 | Example of common reader assignment instructions (Undergraduate Psychology Curriculum Committee, 2013).

graduation. Researchers have found that thoroughly advised students have better learning attitudes and also have higher views of teachers as caring and competent. Also, they rate teachers higher on their evaluations (Clark et al., 2002; Dobransky and Frymier, 2004; Myers, 2004).

WEB FACILITATED AND BLENDED/HYBRID COURSE FORMATS

In the Babson survey report, Allen and Seaman (2013) describe a web-facilitated course as a f2f course with about 1 to 29% of course content delivered online with use of classroom technology, while the definition of a blended/hybrid course delivery method includes about 30 to 79% of course content delivered online through CMS (i.e., Blackboard, eCollege, Desire2Learn, Canvas). Research indicates that blended/hybrid courses may be the best teaching format for a variety of student learning styles, because of its combination of f2f lectures and web-facilitated learning environments (Mansour and Mupinga, 2007). Higher student learning may result from blended course formats where most quizzes and exams are delivered online, therefore, allowing professors to save valuable class time for quality discussions, creative team presentations, and use of the Socratic method for concept clarification. Columbia University's Community College Research Center found evidence for the blended/hybrid delivery format as being equal to the performance of traditional lecture, f2f courses (New York Times - Editorial, 2013). Blended/hybrid courses demand organized synchronous (real time) delivery by professors along with asynchronous online delivery. Some university accreditation guidelines require courses be delivered with specific time ratios of synchronous to asynchronous teaching.

Many teachers do decide to use online technology for testing and extensive discussion board assignments, while keeping

Common Reader Assignment 1—Implicit Association Tests Rubric				
Task category (APA Guidelines, 2007)	**Exceptional (90–100%) 4 points**	**Above average (80–89%) 3 points**	**Average (70–79%) 2 points**	**Below average (69% or less) 1 point**
APA Style: appropriate application (i.e., margins, font—12 pt. Times Roman, etc.), appropriate citation of sources (student paraphrases and knows how to use direct quotes); appropriate mechanical structure (grammar, spelling, etc.). (APA 6.2, 6.3, 6.4, and 7.1).	Student demonstrated a mastery of APA style; journal review was well organized and substantiated; paper was well written.	Student demonstrated an above average understanding of APA style; some citation or structure errors were present; some grammatical problems.	Student demonstrated a basic understanding of APA style (e.g., margins may be appropriate, but citations, where required, were not accurate); grammatical problems are more visible.	Student did not demonstrate an understanding of APA style, errors of font, citations, and structural problems hinder reading of paper.
Completion of tests and attachment of results. (APA 6.2, 6.3, and 6.4).	Completion and attachment evidence from three tests or more.	Completion and attachment results from two tests.	Completion and attachment of results from one test.	No attachment of results from tests.
Discussion of what was learned by completion of the tests. (APA 3.3, 7.2).	Exceptional discussion of test results and personal meaning explored.	Above average discussion of the test results and personal meaning explored.	Basic discussion of the test results and some personal meaning explored.	No discussion of the test results and no personal meaning explored.
Discussion of test results as they relate to the concepts in *Common Reader*. (APA 7.2, 3.3).	Exceptional discussion of test results as they relate to the concepts of *Common Reader*.	Above average discussion of the test results as they relate to the concepts in *Common Reader*.	Basic discussion of the test results as they relate to the concepts in *Common Reader*.	No discussion of the test results as they relate to the concepts in *Common Reader*.
Explanation of how student can use what was learned. (APA 1.3; 3.1, 3.2, 3.3, 3.4, 8.3, 8.5, 8.6).	Exceptional explanation of many insights learned and how to apply what is learned from the tests.	Above average explanation of some insights learned from the tests and how it can be used.	Basic explanation of what was learned from the test and how it can be used.	No explanation of what was learned from the tests and how the information can be used.

FIGURE 3 | Example of rubric for common reader assignment 1 on *Livetext.com* (Undergraduate Psychology Curriculum Committee, 2013).

the in class environment rich with in-depth debates, experiential learning, concept critiques, team presentations, hands-on experiments, and demonstrations (Van Doorn and Van Doorn, 2013). Teaching f2f may be a preferred traditional delivery method for various teachers, but quick Internet access to information through web facilitated technology tools have enhanced versatility. Teachers can play classic experiments found on Youtube.com and provide website links to current event topics and embed them into their PowerPoint presentations presented on in class Wiimote interactive whiteboards like Smart Board (Sacks and Jones, 2011). Bring your own device (BYOD) policies encourage faculty, staff, and students to use their technology on campus and explore current events and utilize Cloud servers for data sharing and storage. On the other hand, technology-savvy students, and professors have found that convenience and economical factors (fewer trips to school) are some of the driving forces behind implementing more technology tools in web-facilitated courses.

Different teaching delivery formats have strengths and weaknesses and may well map to different learning needs of student cohorts (See **Table 1**). For example, it is far more difficult to have a genuine spontaneous sense of humor about a course topic in a purely asynchronous online format, but it is much more likely in f2f formats. Conversely, faculty preplanning, and organization of online courses is very intensive and complex, requiring several weeks of notice before being assigned to teach a completely online course for best design quality. Although, in comparison to f2f classroom structures, it is may be easier for a teacher to effect an extension change for an assignment by a few hours in an online course environment.

ONLINE COURSE FORMAT

While the traditional f2f classroom setting provides many robust benefits, the fully online course format is quickly offering students and teachers flexibility with more course offerings and university applications for access to assignments on mobile platforms (e.g., cell phones, e-readers, iPads). Online portions of courses may be designed with dedicated pre-class PowerPoint lectures with voice over narration for enhanced auditory learning. The challenges to teachers may include staying up-to-date on course delivery software, grade book programs, and CMS training. Educators realize that learning is progressive and find that embracing new technology tools for their courses is a smoother transition when institutions provide continuous training and support them, as core faculty service providers, into the competitive, technological learning environments.

Online courses can meet student needs for economy and efficiency. Most experienced teachers realize that weekly quizzes remain one of the best motivational tools to prompt students to keep up with voluminous, but necessary readings. Research indicates that use of online quizzes may enhance scaffolding learning outside the classroom and encourage student reading motivation (Anthis and Adams, 2012). Full-time, non-traditional student workers with family obligations may find the quiet hours, late into the night, provide needed time to participate in discussion boards, prepare assignments, and answer questions with teachers via live interactive webinars (Van Doorn et al., 2012). Teachers and students alike have found that successful performance with online courses requires very intensive and lengthy sessions sitting at the computer terminal. If a laptop, iPod®, or iPad® is used with good Wi-Fi access, the classroom

environment has no boundaries when the class is enriched with these interactive features. Even social science research is more efficient with use of Surveymonkey.com, Qualtrics.com, and SPSS statistical analysis software. Additional online technology tools include rubric assessment grading on Livetext.com and CMSs like Blackboard, readings on eReader devices, news media videos like NBC Learn and 60 min, National Geographic educational videos, instructional Youtube.com videos, and counseling session simulations with virtual Avatars from Second Life software (Sacks and Jones, 2011). Smartphones as mobile platforms have rapidly made inroads into the educational arena with creative applications that give students instant access to their courses (Smith, 2014). Research indicates that 73% of adults who are online use social media with Facebook as the top choice for communication (Duggan and Smith, 2013). There are, however, some limitations to student use of mobile platforms including security concerns around test administration.

Academic integrity can be compromised with online testing. While in class exams tend to lower cheating behaviors, universities have addressed some of these academic integrity problems for online courses with techniques like Remote Proctor which utilizes biometrics (fingerprinting and facial recognition), optical cameras and audio detection (no phone use allowed during exam), and the zone alarm tool (virtual box surrounding test taker which sounds an alarm if another person enters the testing space), and TurnItIn.com. Techniques like these may help to give instructors the confidence that online test taking is as secure, maybe even more so, than traditional in-class proctoring. Indeed, there may be pedagogical reasons for allowing an online, remotely proctored exam where students can type and reflect on answers that may prove superior against cheating as compared to traditional take-home exams. Overall, web-facilitated and blended/hybrid courses may have strengths beyond the traditional f2f delivery format.

Subsequently, administrators may want to consider collaborative, participative leadership styles that incorporate more faculty-driven pedagogy into training workshops and design selection of CMS. For example, the Quality Matters Program (QM) offers professional faculty-centered workshops and training based on designing fully online and blended courses to a master rubric (Quality Matters Program, 2011). These workshop resources, strategies, and tips from practiced online teachers may help new online teachers better navigate design delivery and lower their preparation time (Quality Matters Program, 2011; Neff, 2013). A continuum exists between how technology savvy workers are from the labels of a "Luddite" to a "Geek," *viz.,* less to higher technologically skilled (Dunn et al., 2011a,b). Technology can be expensive and is not affordable to all seekers of higher education. U.S. News and World Report ("Best online," 2014) rated the best online bachelor's programs based on methodologies of faculty credentials and training, student services and technology, and student engagement. Many online degree programs are taught in 8- to 12-week terms vs. the traditional 16-week semester. These trends need further research to assess course term lengths and respective student mastery of complex subjects, whether there is enough learning time for knowledge transfer efficacy. Educational institutions that provide access to updated computer labs for teachers and students to train and to do classroom assignments, respectively, may help to bridge disparities in online design, delivery, and quality performance across fully online and blended delivery formats.

In summary, when the academic goal of knowledge transfer and learning is foremost, the hybrid/blended format, with its online segment, is a great addition to the pedagogical teaching tools arsenal. The use of the online environment preserves valuable classroom time for those activities which are best accomplished in class, while providing a platform and set of tools that are in some ways superior to that of the traditional classroom setting. Our distinction between traditional and non-traditional student learning styles found in **Table 1** is a useful one in order to understand the appropriate and productive use of these pedagogical tools and structures for higher learning. For the traditional undergraduate student who may be introverted or reticent to participate openly in a large class section like Introduction to Psychology, the online discussion board would allow a more accessible setting, and encourage such participation that otherwise might not occur. Available online support services and tools are at times critical for the non-traditional student living far from campus and pressed for time in retrieving reserve reading materials from a limited-hours campus library. On the other hand, community libraries are offering access to expensive computer and video equipment technology like 3-D printers, iPads, and music video equipment in studios that helps to offset the access and affordability inequities in training new skills (Humphrey, 2014).

DISCUSSION

From this literature review, we hope we created a useful traditional and non-traditional student typology of learner needs for referencing in higher education. Also, we presented several pedagogical recommendations for educators to consider for enhancement of knowledge transfer efficacy in addition to our traditional and non-traditional student needs typology table that includes improving curriculum assessment rigor and consideration for faculty-matched delivery formats. Specifically, by addressing curriculum rigor through the mapping of American Psychological Association (2007, 2013) guidelines and principles to SLOs, matching delivery formats and support services to traditional and emerging, non-traditional student learning needs, and improving technology training for core service providers to reach higher quality online instruction and student performance may together result in higher knowledge transfer efficacy. Also, our review of traditional f2f, web-facilitated and blended/hybrid, and fully online course delivery formats with respective teaching techniques may help to distinguish nuanced teaching and learning differences in these delivery modes. With higher dropout rates among non-traditional students, programs like CUNY's Accelerated Student in Associate Programs (ASAP) are showing remarkable improvements from a low 23% to higher 56% graduation rate on the first two cohorts followed. CUNY's program addresses retention concerns through improving support systems that address advising, student money issues, textbook costs, and flexible morning, afternoon, or evening class schedules (Kirp, 2014). Foremost, ASAP supports many of our typologies of the

non-traditional student (**Table 1**) and their learning needs (Clark et al., 2002; Dobransky and Frymier, 2004; Myers, 2004).

Research suggests that web facilitated and blended/hybrid course formats may have the greatest advantages than either purely in-class or online formats for the non-traditional student cohort. The non-traditional cohort is more focused on learning mastery, pressed for time, and appreciative of a course that is "flexible and well-organized" (Hoyert and O'Dell, 2009). Properly designed and executed by trained teachers, the blended/hybrid format may best fulfill these needs. With research suggesting the blended/hybrid course format is high on learning efficacy, educational institutions may need more funding support to assist faculty training on online asynchronous and synchronized platforms like *Wimba* and *Collaborate,* and for provided classroom space for group learning to maximize concept and skill demonstrations. An implication from this review suggests marked differences and retention results are occurring between f2f, blended/hybrid, and fully online courses and may be associated with the respective traditional and non-traditional learning typologies. Therefore, we hope the learning styles typology **Table 1** may serve as a guide and working reference tool for teachers and administrators who are planning and designing quality courses. Also, consideration of mapping American Psychological Association (2007, 2013) guidelines and principles to SLOs may help guide curriculum committees on designing rigorous assignments for improving student learning. Additional value-added features may include better standards for social science program accountability and improved student performance data for accreditation purposes.

Implications from our new typology model of traditional and non-traditional student needs are expressed in terms of suggestions for future changes in university support, resource allocations, and faculty and student training. The four cohorts of traditional undergraduates and graduates and non-traditional undergraduates and graduates have specific implications presented in **Table 1**. First of all, traditional undergraduates may continue to need daytime classes that are spread out during the week (to accommodate many on-campus and extra-curricular activities), but in the future, they will likely require enhanced support for in class BYOD strategies, supplemented by on-line, blended work, to save valuable classroom time for active teaching and learning. Going forward, instructors of these students should be trained in, and supported with a variety of classroom technology that seamlessly integrates video, sound and live lectures in a captivating manner. Traditional undergraduates will also want and expect interaction with faculty outside of class as faculty club sponsors and mentors. Therefore, the university may need to adjust expectations of teaching loads. The large university two-tier system, where core faculty work primarily as researchers and other faculty and graduate assistants are student-oriented, will likely persist. Secondly, non-traditional undergraduates will need greater support for both training in classroom technology and workshops for relearning cognitive learning and study skills upon their return to the academy. We reemphasize that universities should set-aside computer, writing, and math labs with tutors that are open up to 24 h per day. The non-traditional undergraduates will need more flexibility with night and weekend course offerings built around their work and family obligations. Faculty may need to regularly coach and retrain traditional and non-traditional students, respectively, on robust cognitive study skills (mnemonics, visual imagery, and word associations), goal-setting theories (Locke and Latham, 2002), and self-efficacy (Bandura and Locke, 2003) for enhancing knowledge transfer and achievement goals during their academic journey, and possibly higher retention rates.

While undergraduate students have particular needs, the traditional graduate students have needs for more opportunities to work closely with specific faculty mentors in research projects, academic apprenticeships and teacher training. This cohort needs access to state-of-the-art research laboratories, databases, and libraries. Traditional graduate students should have the inclination to pursue international and collaborative research projects; therefore, the university should seek more foreign-university and research institute cooperation agreements. Because of prior training, recent graduation from college, and desire for more research and writing time, on-line courses and maybe the blended/hybrid and/or flipped classroom, would be most applicable to this group, but clearly, more research is needed here. Finally, the non-traditional graduate cohort in mid-career have their unique student needs and expectations. Non-traditional graduate students tend to require more hands-on, goal-directed and pragmatic, career-oriented learning. In addition to standard lectures, well-designed experiential/kinesthetic and collaborative learning strategies such as role-play, cultural story-telling styles, and academic simulations will benefit students who learn best by doing. From our research, we suggest that this cohort will benefit from fewer on-line courses than traditional graduates, and possibly seek more blended and in-class course combinations. Professors who design their courses with a great deal of front-end organization, whose expectations are very clear, yet flexible in terms of scheduling, may be able to better accommodate non-traditional students life event occurrences, such as military deployments, family roles, and possible elder care responsibilities. Similar to the instructors of non-traditional undergraduates, the teachers of non-traditional graduates will need to be well-trained and experienced in transferring high levels of knowledge in an efficacious manner, again using a combination of streamlined lecture and experiential learning techniques in a live classroom setting. Clearly, both the learning needs of these four distinct student cohorts and the abilities and training of the faculty/instructors who will be charged with knowledge transfer responsibility to meet their learning needs, are very distinct. It is our hope that we have presented a timely typology, and important research agenda for future scholarly work.

In addition, we call for the academy to be cautious of a one-size-fits-all approach, and more closely align resources and expectations with the needs of these different student cohorts. Our category G. *Course Subject Needs* is a preliminary list that needs further research to indicate which discipline courses may benefit from specific delivery modalities. With this typology educational institutions may be able to formulate better strategies to serve traditional and non-traditional student cohorts and provide enhanced rigor to their programs. Although our typologies on learning needs are significantly supported by research findings, it does have limitations. First of all, comparatively, it doesn't

address as many of the graduate student learning styles. The categories consisting of needs for institutional support, computer technology, and educational culture and social activities call for further investigation, especially as the educational experience evolves. Therefore, future research could address the comparisons between undergraduate and graduate student learning styles and the instructor course preparation techniques that maximize efficient and productive learning.

Moreover, our research review revealed an immediate urgency felt by educational administrators to address lower reported retention indicators. Using our learning needs typology as a tool to match quality teaching to the traditional and non-traditional student learners may help to reduce drop out rates and increase retention. We consider this early evidence of a "bounce back" phenomenon that may be occurring when students attempt online learning, suffer poor performance, and then drop out (or hopefully, they decide to proceed back into the f2f classrooms to finish their program requirements toward graduation). Overall, this phenomenon suggests that the traditional in class format of brick and mortar schools may still set space and place for higher performance and learning, when viewed over a student's entire educational program. More behavioral research is needed to address pedagogical delivery methods, these online student experiences, behaviors, and institutional support experiences. Recent research on advisement duty by faculty and academic support staff was found to be an important part of the educational social process, where monitoring and mentoring may improve student institutional commitment (IC) (Beck and Milligan, 2014). Further support found advising as a procedural process that monitors and evaluates students' satisfactory performance, knowledge mastery, and guides the student to completion of degree program courses. As a result, students find they meet their successful, graduation goals (Kirp, 2014).

Further implications from our research review include institutional acknowledgement of present and future teacher and student training needs, especially with continuous support services during rapid advances in educational technology. Administrators must consider best fit options for teachers based on their knowledge, skills, and abilities and their training for matching them to their preferences and most productive course delivery methods, whether in f2f classes, 100% online courses, and/or blended/hybrid courses. Moreover, social networks are where Americans spend 23% of their online time with Internet service (Nielsen Social Media Report: Q3, 2011). Therefore, educational administrators may need to consider how best to facilitate some faculty-led strategies for pedagogical training of "best practices" for course delivery formats, stronger social science curriculums, the use of social media, and adult learner continuing education (Caffarella and Daffron, 2013). Opportunities exist for teachers to easily incorporate language assignments (Mango Languages, 2011) and even study abroad opportunities to help build multilingual abilities and globally confident, ready students with worldview perspectives. Setting higher student performance goals and training innovative online teaching methods may help to broaden student job skills, enhance diversity knowledge through inclusive teaching, and promote lifelong career marketability for students. The efficacious transfer of knowledge to 21st century students is important for facilitating higher performance, and overall, student mastery of disciplinary content and should be a part of the Academy's focus.

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REFERENCES

Allen, E. I., and Seaman, J. (2013). *Changing Course: Ten Years of Tracking Online Education in the United States*. Babson Survey Research Group. Available online at: http://www.onlinelearningsurvey.com/reports/changingcourse.pdf

American Association of Community Colleges. (2014). *Community College Enrollment*. Available online at: http://www.aacc.nche.edu/AboutCC/Trends/Pages/enrollment.aspx

American Psychological Association. (2007). APA guidelines for the undergraduate psychology major. Available online at: April 2011 from http://www.apa.org/ed/precollege/about/psymajor-guidelines.pdf

American Psychological Association. (2013). Principles for quality undergraduate education in psychology: Executive Summary. Available online at: January 2013 from http://www.apa.org/education/undergrad/principles.aspx

Andrews, A. (2009). *The Noticer: Sometimes, all a Person Needs is a Little Perspective*. Nashville, TN: W Publishing Group, Thomas Nelson.

Anthis, K., and Adams, L. (2012). Scaffolding: relationships among online quiz parameters and classroom exam scores. *Teach. Psychol.* 39, 284–287. doi: 10.1177/0098628312456629

Atkinson, R. C., and Shiffrin, R. M. (1968). "Human memory: a proposal system and its control processes," in *The Psychology of Learning and Motivation*, Vol. 2, eds K. W. Spence and J. T. Spence (Orlando, FL: Academic Press), 89–195.

Bandura, A., and Locke, E. A. (2003). Negative self-efficacy and goal effects revisted. *J. Appl. Psychol.* 87, 87–99. doi: 10.1037/0021-9010.88.1.87

Beaghan, J. P. (2013). Non-traditional student performance and attitudes toward online and other forms of distance learning. *Rev. Bus. Res.* 13, 23–28.

Beck, H. P., and Milligan, M. (2014). Factors influencing the institutional commitment of online students. *Internet High. Educ.* 20, 51–56. doi: 10.1016/j.iheduc.2013.09.002

Brufee, K. A. (1999). *Collaborative Learning: Higher Education, Interdependence, and the Authority of Knowledge*. Baltimore, MD: The John Hopkins University Press.

Buskist, W., Carlson, J. R., Christopher, A. N., Prieto, L., and Smith, R. A. (2008). Models and exemplars of scholarship in the Teaching of Psychology. *Teach. Psychol.* 35, 267–277. doi: 10.1080/00986280802373908

Caffarella, R. S., and Daffron, S. R. (2013). *Planning Programs for Adult Learners*. San Francisco, CA: Jossey-Bass, John Wiley & Sons, Inc.

Chen, J., Moran, S., and Gardner, H. (2009). *Multiple Intelligences Around the World*. New York, NY: Jossey-Bass.

Christensen, C. M., and Horn, M. B. (2013, November 1). Innovation imperative: Change everything. *The New York Times*.

Clark, R. K., Walker, M., and Keith, S. (2002). Experimentally assessing the student impact of out-of-class communication: office visits and the student experience. *J. Coll. Stud. Dev.* 43, 824–837.

Cooper, M. (2014, January 13). The disadvantage of a non-accredited college. *GlobalPost – International News*. Available online at: http://everydaylife.globalpost.com/disadvantages-nonaccredited-college-5816.html

Daffron, S. R., and North, M. W. (2011). *Professional Practices in Adult Education and Lifelong Learning: Successful Transfer of Learning Model*. Malabar, FL: Krieger Publishing Company.

DeBoth, C. J., and Dominowski, R. L. (1978). Individual differences in learning: visual versus auditory presentation. *J. Educ. Psychol.* 70, 498–503. doi: 10.1037/0022-0663.70.4.498

Dobransky, N. D., and Frymier, A. B. (2004). Developing teacher-student relationships through out-of-class communication. *Commun. Q.* 52, 211–223. doi: 10.1080/01463370409370193

Duggan, M., and Smith, A. (2013, December 30). Social media update 2013. Available online at: http://www.pewinternet.org/Reports/2013/Social-Media-Update.aspx

Dunn, D. S., Wilson, J. H., and Freeman, J. E. (2011a). "Approach or avoidance? Understanding technology's place in teaching and learning," in *Best Practices for Technology-Enhanced Teaching and Learning: Connecting to psychology and the social sciences*, eds D. S. Dunn, J. H. Wilson, J. E. Freeman, and J. R. Stowell (New York, NY: Oxford University Press, Inc.), 17–34.

Dunn, D. S., Wilson, J. H., Freeman, J. E., and Stowell, J. R., (eds.). (2011b). *Best Practices for Technology-Enhanced Teaching and Learning: Connecting to Psychology and the Social Sciences.* New York, NY: Oxford University Press, Inc.

Dweck, C. S. (1999). *Self-Theories: Their Role in Motivation, Personality, and Development*. Philadelphia, PA: Psychology Press.

Editorial. (2013, February 18). *The trouble with online college.* [Editorial]. *New York Times.* Available online at: http://www.nytimes.com/2013/02/19/opinion/the-trouble-with-online-college.html

Estes, C. (2013, October). Online learning is bringing huge change to higher education. What have we learned so far? *SKY Magazine*, 95–106.

Fischer, K. (2010, July 8). Foreign – student enrollments in U. S. rise despite global recession. *The Chronicle of Higher Education.* Available online at: January 5, 2014 http://chronicle.com/article/Foreign-Student-Enrollments-in/66214/

Forbus, P., Newbold, J. J., and Mehta, S. S. (2011). A study of non-traditional and traditional students in terms of their time management behaviors, stress factors, and coping strategies. *Acad. Educ. Leadership J.* 15, 109–125.

Gilardi, S. (2011). University life of non-traditional students: engagement styles and impact on attrition. *J. High. Educ.* 82, 33–53. doi: 10.1353/jhe.2011.0005

Gladwell, M. (2004). *Blink: the Power of Think without Thinking*. New York, NY: Little, Brown and Company.

Goleman, D. (1995). *Emotional Intelligence.* New York, NY: Bantam Books.

Hermida, J. (2010). Inclusive teaching: an approach for encouraging non-traditional student success. *Int. J. Res. Rev.* 5, 19–30.

Hoyert, M. S., and O'Dell, C. D. (2009). Goal orientation and academic failure in traditional and non-traditional aged college students. *Coll. Stud. J.* 43, 1052–1061.

Humphrey, K. (2014, January 10). Libraries become tech hubs for the digitally inclined. *Star Tribune (Minneapolis), Ledger-Enquirer,* E1.

Jensen, S. A. (2011). In-class versus online video lectures: similar learning outcomes, but a preference for in-class. *Teach. Psychol.* 38, 298–302. doi: 10.1177/0098628311421336

Jinkens, R. C. (2009). Non-traditional students: who are they? *Coll. Stud. J.* 43, 0146393420091201

Kim, K., and Bonk, C. J. (2006, January 1). The future of online teaching and learning in higher education: the survey says…, *EDUCAUSE Quarterly.* Available online at: http://www.educause.edu/ero/article/future-online-teaching-and-learning-higher-education-survey-says

Kirp, D. L. (2014, January 9). How to help college students graduate. *New York Times.* A21.

Korenman, L. M., and Peynircioglu, Z. F. (2007). Individual differences in learning and remembering music: auditory versus visual presentation. *J. Res. Music Educ.* 55, 48–64. doi: 10.1177/002242940705500105

Kristjønsson, K. (2006). "Emotional Intelligence" in the classroom? An aristolelian critique. *Educ. Theory* 56, 39–56. doi: 10.1111/j.1741-5446.2006.00002.x

Lewin, T. (2013, December 11). After setbacks, online courses are rethought. *New York Times.* A1.

Locke, E. A., and Latham, G. P. (2002). Building a practically useful theory of goal-setting and task motivation. *Am. Psychol.* 57, 705–717. doi: 10.1037/0003-066X.57.9.705

Lorayne, H., and Lucas, J. (1974). *The Memory Book*. NewYork, NY: Ballentine.

Lundberg, C. A., McIntire, D. D., and Creasman, C. T. (2008). Sources of social support and self-efficacy for adult students. *J. Coll. Couns.* 11, 58–72. doi: 10.1002/j.2161-1882.2008.tb00024.x

Mansour, B. E., and Mupinga, D. M. (2007). Students' positive and negative experiences in hybrid and online classes. *Coll. Stud. J.* 41, 242–248.

Mango Languages. (2011). [Computer software]. Farmington Hills, MI. Available online at: www.mangolanguages.com/libraries/products-overview/mango-mobile/

Mebane, M., Porcelli, R., Iannone, A., Attanasio, C., and Francescato, D. (2008). Evaluation of the efficacy of affective education online training in promoting academic and professional learning and social capital. *Int. J. Hum. Comp. Interact.* 24, 68–86. doi: 10.1080/10447310701771498

Miller, S. P., and Hudson, P. J. (2007). Using evidence-based practices to build mathematics competence related to conceptual, procedural, and declarative knowledge. *Learn. Disabil. Res. Pract.* 22, 47–57. doi: 10.1111/j.1540-5826.2007.00230.x

Most, L. R., Kazmer, M. M., and Marty, P. F. (2013). Intangible factors influencing the successful completion of graduate LIS coursework by non-traditional students: a case of two IMLS-funded scholarship projects. *J. Educ. Libr. Inf. Sci.* 54, 205–219.

Munro, L. (2011). 'Go boldly, dream large!': the challenges confronting non-traditional students at university. *Aust. J. Educ.* 55, 115–131. doi: 10.1177/000494411105500203

Murray, B. (2000). Teaching students how to learn. *Monitor Psychol.* 31, 62. Available online at: www.apa.org/monitor/jun00/howtolearn.aspx

Myers, S. A. (2004). The relationship between perceived instructor credibility and college student in-class and out-of-class communication. *Commun. Rep.* 17, 129–137. doi: 10.1080/08934210409389382

Neff, K. S. (2013). *Teaching Psychology Online: Tips and Strategies for Success*. New York, NY: Psychology Press.

Nemanich, L., Banks, M., and Vera, D. (2009). Enhancing knowledge transfer in classroom versus online settings: the interplay among instructor, student, content, and context. *Dec. Sci. J. Innovat. Educ.* 7, 123–148. doi: 10.1111/j.1540-4609.2008.00208.x

Nielsen Social Media Report: Q3. (2011, September 11). *Spending Time, Money, and Going Mobile.* Available online at: http://blog.nielsen.com/nielsenwire/online_mobile/social-media-report-spending-time-money-and-going-mobile/

Paivio, A. (1969). Mental imagery in associative learning and memory. *Psychol. Rev.* 76, 241–263. doi: 10.1037/h0027272

Paivio, A. (2008). "Looking at reading comprehension through the lens of neuroscience," in *Comprehension Instruction: Research-Based Best Practices*, eds C. C. Block and S. R. Parris (New York, NY: Guilford Press), 101–113.

Pearce, J., Down, B., and Moore, E. (2008). Social class, identity and the 'good' student: negotiating university culture. *Aust. J. Educ.* 52, 257–271. doi: 10.1177/000494410805200304

Phillips, V. (2013). *Georgia Tech to use MOOCs to deliver cheap online degrees to 10,000 computer geeks*. Available online at: http://www.geteducated.com/elearning-education-blog/

Quality Matters Program. (2011). *Quality Matters Rubric Standards 2011-2013 Edition with Assigned Point Values*. Available online at: www.qualitymatters.org/rubric

Reay, D., Crozier, G., and Clayton, J. (2010). 'Fitting in' or 'Standing out': working-class students in UK higher education. *Br. Educ. Res. J.* 36, 107–124. doi: 10.1080/01411920902878925

Reed, S. K. (2013). *Cognition: Theories and Applications, 9th Edn*. Belmont, CA: Wadsworth, Cengage Learning.

Reevy, G. M. (2012). Storytelling as a strategy for teaching psychology courses. *Psychol. Learn. Teach.* 11, 272.

Roberts, S. (2011). Traditional practice for non-traditional students? Examining the role of pedagogy in higher education retention. *J. Further High. Educ.* 35, 183–199. doi: 10.1080/0309877X.2010.540320

Rosenthal, G. T., Folse, E. J., Alleman, N. W., Bourdreaux, D., and Von Bergen, C. (2000). The one-to-one survey: traditional versus non-traditional student satisfaction with professors during one-to-one contacts. *Coll. Stud. J.* 34, 315–320.

Sacks, M. B., and Jones, B. A. (2011). "Interact! Teaching Using an Interactive Whiteboard," in *Best Practices for Technology-Enhanced Teaching and Learning: Connecting to Psychology and the Social Sciences*, eds D. S. Dunn, J. H. Wilson,

J. E. Freeman, and J. R. Stowell (New York, NY: Oxford University Press, Inc.), 171–182.

Shepard, R. N. (1967). Recognition memory for words, sentences, and pictures. *J. Verbal Learn. Verbal Behav.* 6, 156–163. doi: 10.1016/S0022-5371(67)80067-7

Sitzmann, T. (2011). A meta-analysis of self-regulated learning in work-related training and educational attainment: what we know and where we need to go. *Psychol. Bull.* 137, 421–442. doi: 10.1037/a0022777

Smith, A. (2014, January 6). Race and ethnicity, digital divide: African Americans and technology use. *The Pew Research Center's Internet & American Life Project.* Available online at: http://www.pewinternet.org/Reports/2014/African-American-Tech-Use.aspx

Sternberg, R. J., and Grigorenko, E. L. (1997). Are cognitive styles still in style? *Am. Psychol.* 52, 700–712. doi: 10.1037/0003-066X.52.7.700

Strage, A. (2008). Traditional and non-traditional college students' descriptions of the 'ideal' professor and the 'ideal' course and perceived strengths and limitations. *Coll. Stud. J.* 42, 225–231.

Trudeau, G. B. (2011, July 17). Doonesbury comic strip. Available online at: http://www.gocomics.com/doonesbury/2011/07/17

Undergraduate Psychology Curriculum Committee. (2013). *Student Learning Objectives and Common Reader Assignment with Grading Rubric.* Troy, AL: Troy University.

U.S. Department of Education. (2014, January 13). The database of accredited post-secondary institutions and programs. Available online at: http://ope.ed.gov/accreditation/

U.S. News and World Report. (2014, January). Best online Bachelor's programs. Available online at: http://www.usnews.com/education/online-education/bachelors/rankings?int=b88eac

Van Doorn and Chesterman. (2012, January 3–6). *Traditional and Non-Traditional Psychology Students: Knowledge Transfer Need Differences with f2f or Online Courses & Advisor/Mentoring Exchange Relationships.* Tampa, FL: Roundtable Participant Idea Exchange at the National Institute on the Teaching of Psychology conference.

Van Doorn, J. R., and Van Doorn, J. D. (2013). "The quest for efficacy: Blending creative teaching formats for student success through quality in-class knowledge transfer demonstrations and critical thinking assessments online," in *Presentation at Vancouver International Conference on the Teaching of Psychology*. Vancouver, BC, British Columbia.

Van Doorn, J. R., Van Doorn, J. D., and Currington, S. M. (2012). Teaching by the moonlight: new challenges for teachers of psychology and need differences. *Psychol. Learn. Teach. J.* 11:276.

Vygotsky, L. S. (1978). *Mind in Society*. Cambridge, MA: MIT Press.

Wang, C.-H., Shannon, D. M., and Ross, M. E. (2013). Students' characteristics, self-regulated learning, technology self-efficacy, and course outcomes in online learning. *Distance Educ.* 34, 302–323. doi: 10.1080/01587919.2013.835779

Wardley, L. J., Belanger, C. H., and Leonard, V. (2013). Institutional commitment of traditional and non-traditional-aged students: a potential brand measurement? *J. Mark. High. Educ.* 23, 90–112. doi: 10.1080/08841241.2013.810691

Weiermann, B. (2012). Implicit task sequence learning with auditory stimuli. *J. Cogn. Psychol.* 24, 468–475. doi: 10.1080/20445911.2011.653339

Wilkinson, J. (1984). "Varieties in teaching," in *The Art and Craft of Teaching*, ed M. M. Gullette (Cambridge, MA: Harvard University Press), 1–9.

Xu, D., and Jaggars, S. S. (2013). *Adaptability to Online Learning: Differences across Types of S students and Academic Subject Areas. CCRC Working Paper No. 54.* Community College Research Center. Available online at: http://ccrc.tc.columbia.edu/media/k2/attachments/adaptability-to-online-learning.pdf

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Death to weak PowerPoint: strategies to create effective visual presentations

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THE PROBLEM WITH POWERPOINT

There is nothing more frustrating than sitting through a presentation bombarded by slide after slide of small text, difficult to read graphs, irrelevant clip art images, and poorly designed templates. Often to blame is the use and abuse of PowerPoint[1] (e.g., Tufte, 2003; Bumiller, 2010). Academics typically only endure weak PowerPoint presentations at conferences, while university students may be exposed to them several times a day for an entire semester. Strong PowerPoint presentations enhance student engagement and help students retain information (e.g., Susskind, 2005), while weak PowerPoint slides can lead to distraction, boredom, and impeded learning (Savoy et al., 2009).

The authors of this paper became interested in improving their PowerPoint slides after observing several presentations that badly misused PowerPoint, and realizing that they made many of the same mistakes. Our slides used standard, boring templates; were text heavy, and included grainy gif images—embarrassingly, some of which were even animated. For example, **Figure 1A** contains a slide that was prepared for a lecture in an introductory psychology course. The slide uses a template that makes the text difficult to read, there are several lengthy bullets, and the photos are too small. To make matters worse, the instructor had the slide heavily animated—bullet points flew in, swirled around, and even made sound. Needless to say, students were not impressed.

[1]Note that in this article we are using the denotation PowerPoint to refer to any presentation software (e.g., Keynote, Impress, etc.).

Outstanding PowerPoint slides will not save a weak lecture; however, weak PowerPoint will certainly diminish a strong one. The purpose of this brief article is to provide some basic suggestions and resources for instructors who wish to improve their PowerPoint presentations, and in doing so, create more engaging and informative lectures for students.

THE BASICS OF POWERPOINT

For the most part, graduate school does not train instructors how to properly use presentation software. Excluding basic slides provided by publishing companies, instructors are given little guidance on what a PowerPoint presentation should look like. The software itself does not provide any assistance. Upon opening PowerPoint, users are presented with standard templates with space to add a title at the top of the slide, and a block of text to add bullet points. For the most part, this has been shown to be an ineffective means to convey information (Garner and Alley, 2011). Whenever possible, we recommend avoiding the use of templates that are included with PowerPoint. The images on the templates are tired, as templates with images that look the best tend to be the ones that are used the most.

Creating a well-designed PowerPoint presentation is not intuitive (Kosslyn et al., 2012), so where should an instructor look for guidance? Fortunately, there are many excellent resources. Books such as Presentation Zen (Reynolds, 2012), Slide:ology (Duarte, 2008), and Presentation Secrets (Kapterev, 2011) focus on design, and provide a different way of approaching PowerPoint. From these resources, and the literature on design, educational and cognitive psychology, we can find some basic points that should be considered when using PowerPoint for lectures.

FONT AND TEXT

Beyond aesthetics, font choice has an impact on how students process information. For example, Song and Schwarz (2008) presented students with instructions for an exercise routine that was printed in either an easy-to-read font, or one that was difficult to read. The researchers found that students who read the instructions in a difficult-to-read font were less willing to make the exercise a part of their daily routine, and perceived the exercise as requiring more time to complete than those students who read the same instructions in a clear font. Other researchers have found a similar impact with difficult-to-read fonts (e.g., Schwarz, 2004; Rhodes and Castel, 2008; Sanchez and Jaeger, 2014). A poorly chosen font can negatively impact the perception of the material, and the perception of the presenter themselves (Oppenheimer and Frank, 2008). Even an announcement as monumental as the discovery of the Higgs Boson can be marred by a bad font. Comic Sans was used in the presentation of the discovery, and received mockery in the press (e.g., Urquhart, 2011). Font choice may seem inconsequential, but can have a major impact on a presentation.

Presenters should be wary of the colors used for presenting text and graphs. Color-blindness is not uncommon. For this reason, slides should not have color

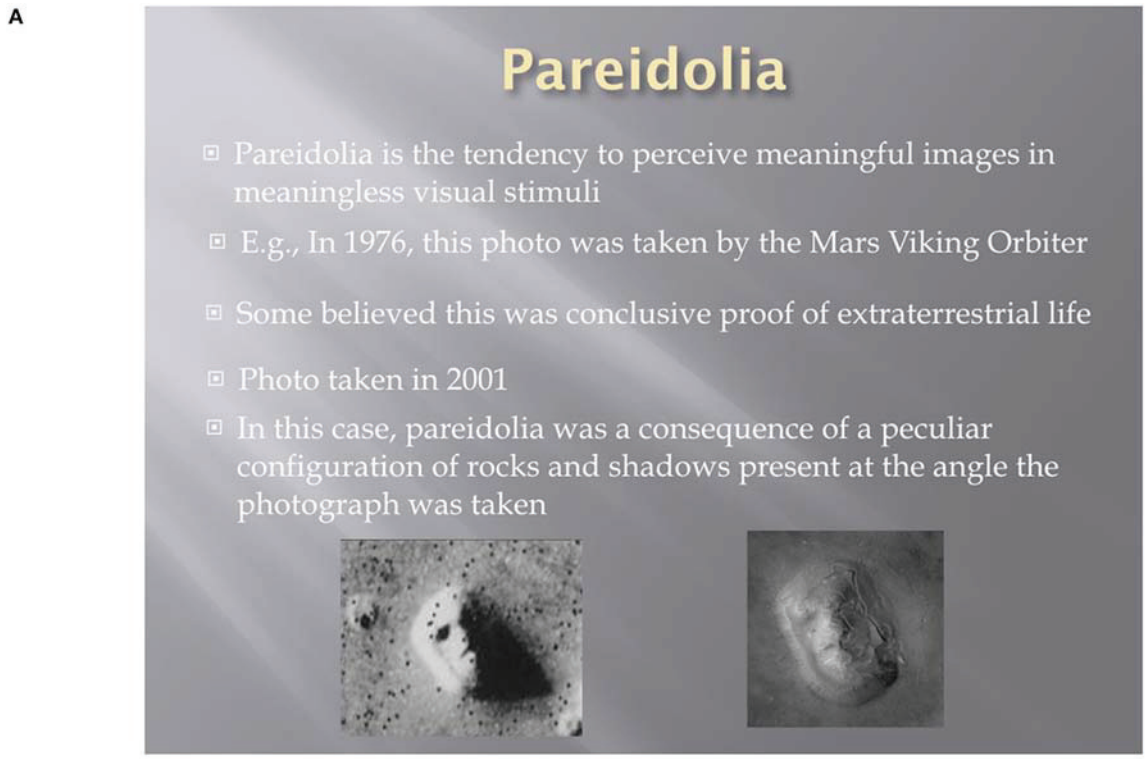

FIGURE 1 | (A) A poorly designed slide. This slide relies on text-heavy bullets. The photos are too small, and the text does not stand out against the background. **(B)** Another approach to presenting the information in **(A)**. Unnecessary text is removed, the photos are enlarged, and the content is broken down into two separate slides. The instructor should discuss the material in the bullet points on the slide in **(A)**, but it need not be printed on the slide.

schemes with red on green or blue on yellow. For the most part, we recommend using either white on black, or black on white. While having white text on a black background can lead to some bleeding of the text, it has been our experience that students are still able to see the material clearly. This is not to say that all slides should be simply black and white. Text boxes can be placed over graphics and images, allowing for variety in the slides, and clarity in the text (see **Figure 1B**). While the research on the ideal font is mixed (e.g., Duarte, 2008), Mackiewicz (2007) recommends Gill Sans as a safe choice.

ANIMATIONS

When PowerPoint was first available, there was a certain novelty to having text fly onto the screen, spin around, burst into flames, and fly out. The reality now is that students are used to these effects, and they are more distracting than anything else. There are times when animations

are necessary, such as when an instructor may not want all of the text on a slide to be available at once to students. While it may be useful for separate points to appear on the screen at different times, there should be no distracting animations (Daffner, 2003).

VIDEOS AND IMAGES

The choice of images or graphics is important. Verbal information supplemented with appropriate images is better retained than information presented simultaneously with both graphics and text (Mayer, 2009). This means that students remember more if instructors speak to images on a slide, rather than images *and* redundant text (i.e., bullet points that reiterate what the speaker is discussing). That said, images and graphics must be chosen carefully. The images used on a slide must be consistent with the message of the presenter. Images that are superfluous or inconsistent with the instructor's verbal output may actually hinder student retention (e.g., Bartsch and Cobern, 2003). Instructors should also be sure to avoid low-resolution images (i.e., no less than 1600×1200 pixels), clipart, or images with watermarks. A grainy image with a watermark is distracting and may come across as unprofessional. The same is true of clip art. Including clip art in a presentation is somewhat dated, and again, is often viewed as unprofessional (Alley, 2013). Fortunately, there are a number of resources available to find suitable images[2].

Videos should be embedded in presentations. Relying on an internet connection to stream content can be risky and break up the flow of the presentation. There are numerous sites available to legally download video content. Instructors that are concerned with copyright issues should check with the copyright specialist at their institution.

Keeping the above points in mind, let us revisit **Figure 1A**. A better approach to this slide is to remove unnecessary text, enlarge the images, and break the single slide down into two separate slides, as we see in **Figure 1B**. With this approach, the instructor can place the focus on the images, which is critical in this example, and speak to what the students are viewing. This is far more engaging than reading the bullet points off of the slide in **Figure 1A**.

[2]Google images offers a wide selection of free images, though there may be copyright issues. Other valuable online resources include Getty Images, iStock Photo, Flickr Creative Commons, and Everystockphoto.

THE STUDENT EXPERIENCE

In our experience, students need some preparation to deal with PowerPoint presentations that are not loaded with text. As students have become used to seeing text-heavy slides, many have gotten into the routine of simply writing down everything that is on the slide and moving on. With less text on slides, and graphics that enhance the key points of the instructor, students need to pay attention to what is actually being said in the classroom. As well, students are not going to be able to write down everything, as some are previously accustomed to. At the beginning of the term, we provide students with an overview of how the slides are going to look also give instruction on how students can become active listeners. Students are taught to listen for key points, minimize the amount of note taking and maximize the amount of attention that is spent on what the instructor is saying. There can certainly be an adjustment period for students. Still, we typically find that attendance goes up, student engagement increases and grades improve.

WHO HAS THE TIME?

Between writing grants, collecting data, writing papers, and preparing lectures, there is intense pressure placed on instructors. To try to minimize the time spent on preparing lectures, many instructors understandably spend little time creating PowerPoint slides, or simply use slides provided by the publisher. Unfortunately, publisher slides tend to be text heavy, and often do nothing more than regurgitate textbook material. While many instructors wish to improve their slides, there is a common concern that there is simply not enough time to do so. In our experience, properly created slides actually take less time to create than the more commonly used text-heavy slides with a header and several bullets. We encourage instructors to look at their current slides and consider if the images on the slides are complimenting what is being said and if the text is enhancing the lecture. If the answer to either of these questions is negative, the instructor needs to decide whether to stop using PowerPoint—which is not necessarily a bad option, we have both seen brilliant presentations that did not use PowerPoint—or how to change things for the better.

One benefit of updating and enhancing PowerPoint slides is that it forces instructors to think about the content of their course. If there is not an image, or small amount of text that can explain a concept, it could be that the concept does not lend itself to the style of PowerPoint—in that case, PowerPoint should not be used. It might also be that the instructor is not familiar enough with the material to be able to create an appropriate slide. We found that when updating our lectures, topics that we were comfortable with were easy to present with minimal text and an appropriate image. This was more challenging for topics that we were less comfortable with. This forced us to review our course material, and ultimately, improve the quality of the lectures.

As previously mentioned, many instructors use the slides provided by publishing companies. While we argue these slides don't stand up well on their own, they still have value. The publisher's slides contain the basics from the textbook, and may be useful as a way to frame lectures. These slides could be considered an outline of what may be covered, and then altered to reduce text, add meaningful images or graphs, and supplemented with relevant examples from the literature.

FINAL THOUGHTS

Student engagement can be difficult, as students have more temptation than ever to tune out from a dull lecture. Laptops, phones and tablets all contain the lure of social media, surfing the web, text messaging, or simply reading a magazine or book, and this can all be done under the guise of listening to a lecturer. Effective PowerPoint presentations can prevent student distraction and facilitate a better student experience. There is no need for students to endure substandard presentations, and as such, we challenge all instructors to put weak PowerPoint to rest.

REFERENCES

Alley, M. (2013). "Critical error 8 following the common practices of PowerPoint talks," in *The Craft of Scientific Presentations* (New York, NY: Springer), 171–201.

Bartsch, R. A., and Cobern, K. M. (2003). Effectiveness of PowerPoint presentations in lectures. *Comput. Educ.* 41, 77–86. doi: 10.1016/S0360-1315(03)00027-7

Bumiller, E. (2010, April 26). We have met the enemy and he is PowerPoint. *The New York Times*. (Accessed August 4, 2014), Available online at: http://www.nytimes.com/2010/04/27/world/27powerpoint.html.

Daffner, R. H. (2003). On improvement of scientific presentations: using PowerPoint. *Am. J. Roentgenol.* 181, 47–49. doi: 10.2214/ajr.181.1.1810047

Duarte, N. (2008). *Slide: Ology: the Art and Science of Creating Great Presentations.* Toronto, ON: O'Reilly Media.

Garner, J. K., and Alley, M. (2011). PowerPoint in the psychology classroom: lessons from multimedia learning research. *Psychol. Learn. Teach.* 10, 95–106. doi: 10.2304/plat.2011.10.2.95

Kapterev, A. (2011). *Presentation Secrets*. New York, NY: Wiley.

Kosslyn, S., Kievit, R. A., Russell, A. G., and Shephard, J. M. (2012). PowerPoint® presentation flaws and failures: a psychological analysis. *Front. Psychol.* 3:230. doi: 10.3389/fpsyg.2012.00230

Mackiewicz, J. (2007). Audience perceptions of fonts in projected PowerPoint text slides. *Tech. Commun.* 54, 295–307.

Mayer, R. (2009). *Multimedia Learning*. New York, NY: Cambridge University Press.

Oppenheimer, D. M., and Frank, M. C. (2008). A rose in any other font would not smell as sweet: effects of perceptual fluency on categorization. *Cognition* 106, 1178–1194. doi: 10.1016/j.cognition.2007.05.010

Reynolds, G. (2012). *Presentation Zen: Simple Ideas on Presentation Design and Delivery*. 2nd Edn., Berkeley, CA: New Riders.

Rhodes, M. G., and Castel, A. D. (2008). Memory predictions are influenced by perceptual information: evidence for metacognitive illusions. *J. Exp. Psychol.* 137, 615–625. doi: 10.1037/a0013684

Sanchez, C. A., and Jaeger, A. J. (2014). If it's hard to read, it changes how long you do it: reading time as an explanation for perceptual fluency effects on judgment. *Psychon. Bull Rev.* doi: 10.3758/s13423-014-0658-6. [Epub ahead of print].

Savoy, A., Proctor, R. W., and Salvendy, G. (2009). Information retention from PowerPointTM and traditional lectures. *Comput. Educ.* 52, 858–867. doi: 10.1016/j.compedu.2008.12.005

Schwarz, N. (2004). Metacognitive experiences in consumer judgment and decision making. *J. Consum. Psychol.* 14, 332–348. doi: 10.1207/s15327663jcp1404_2

Song, H., and Schwarz, N. (2008). If it's hard to read, it's hard to do: processing fluency affects effort prediction and motivation. *Psychol. Sci.* 19, 986–988. doi: 10.1111/j.1467-9280.2008.02189.x

Susskind, J. E. (2005). PowerPoint's power in the classroom: enhancing students' self-efficacy and attitudes. *Comput. Educ.* 45, 203–215. doi: 10.1016/j.compedu.2004.07.005

Tufte, E. R. (2003, September). PowerPoint is Evil. *Wired*. (Accessed August 10, 2014), Available online at: http://www.wired.com/wired/archive/11.09/ppt2.html.

Urquhart, R. (2011, December 14). *CERN Higgs Boson V Comic Sans Debacle*. Available online at: http://www.huffingtonpost.co.uk/robert-urquhart/cern-higgs-boson-comic-sans-_b_1148058.html.

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Keywords: teaching educational psychology, initial teacher education, twenty-first century

I am always attempting to develop new and better ways to teach beginning teachers "all there is to know" about child development and special education. Over the years this process has lead me to feel more and more disillusioned. I am convinced that we need a total revamp of how we approach teaching educational psychology and propose that our discipline re-define what is considered to be essential knowledge and skills for teachers in the twenty-first century. I begin my argument with a review of typical educational psychology courses in initial teacher education, and what my experience with content and process has been over the past 19 years of my career. I then outline the basic tenets of twenty-first century learning and compare these to a "typical" introductory course in educational psychology. Finally, I suggest possible alternatives to the current curriculum and pedagogy of educational psychology in order for it to align with the principles of twenty-first century learning.

TYPICAL INTRODUCTORY COURSE IN EDUCATIONAL PSYCHOLOGY

THE CONTENT

In Canada, most Bachelor of Education programs offer an introductory course in child development, typically over one semester of the program. The semesters tend to be 13 weeks in duration, with a minimum of 36–39 contact hours for three course credits. In the 19 years that I have been teaching the introductory child development course, I have never ended the course saying, "Wow, I ran out of things to teach." In fact, I usually end up cutting out content, having responded to the needs of my teacher candidates (TCs). For example, though I schedule several weeks for the TCs to digest basic statistics and research methods in order to critically review research articles, some TCs inevitably struggle with the concepts and require more time to synthesize the content. On other occasions I have made adjustments to the pace and content of the course, based on some field experiences that have been discussed in class. But never have I finished my courses and felt that I covered everything that I believed was important, outlined in the textbook, or even listed on the course outline, for that matter.

What are the common topics that we usually include in our child development courses? Theories of development and learning, of course! Have any of us ever taught the course without ensuring that Piaget was covered? Or Vygotsky? Or Gardner? Those seem to be among the "biggies" to introduce. I consider myself lucky if we ever get to theories of motivation, metacognition, and cognitive processes. In addition to the course outline and content, we are also required by our department to infuse cross-cultural awareness, technology, and classroom management. The plate of topics and content is enormous!

Friesen and Jardine (2010) echo this sense of "too much to cover in too little time" in their discussion of twenty-first century learning. They note that schools are "… accelerating, continually differentiating and multiplying the tasks that are asked of them, while, at the same time, attempting to leave in place the structures and practices that were responsive and responsible ventures over one hundred years ago" (p. 5). The same can be said of post-secondary education. Though teacher educators espouse "best practice"—teaching relevant curriculum in meaningful ways that engage all learners—we aren't practicing what we are preaching. There seems to be too much content, compressed into too little time, and this leads instructors and students to revert to the "memorize and regurgitate" pattern of teaching and learning.

THE PROCESSES

I have tried to relieve my stress and discomfort about omitting content by devising assignments that help to synthesize and apply the material in meaningful ways. For example, most recently this has taken the form of analyzing TCs' practicum lesson plans so that they will better understand "why they are doing, what they are doing." Despite these efforts to connect theory to practice, and to make the course "relevant," I can't help but feel that the courses have been marathons and the students and I just runners in the pack, trying to get finished. "Check. Another course down," says the TC.

Yet, the purposes of having educational psychology situated within teacher education programs is so that teachers can better understand the learning process, and to ultimately improve education (Berliner, 2012). The current curriculum and pedagogy of introductory educational psychology courses, however, put our discipline in jeopardy of being deemed irrelevant for pre- or in-service teachers.

THE BIGGER QUESTION

Every year I change the assignments, resources, and daily lesson plans to help TCs develop essential understandings. Every year I wonder (and would encourage others to consider): *What do teacher candidates really need to know in order to make beginning teaching a successful*

experience and as a foundation for later practice?

RE-FOCUSING INTRODUCTORY EDUCATIONAL PSYCHOLOGY COURSES

While the contributions of legendary educational psychologists have enriched our discipline and served to improve teaching practice, we must look for new ways to keep our discipline relevant to modern-day classrooms and instruction. As Berliner and Calfee state in the first Berliner and Calfee (2004), our discipline changed substantially from twentieth century pre-war eras, and it will no doubt look significantly different in the years to come. I am suggesting that one possible way to realign our practice is by drawing upon the directives for twenty-first century learning. Every province and territory in Canada has position papers which outline the direction of public education for the new millennium (Boudreault et al., 2012/2013; C21 Canada, 2012; Dunleavy et al., 2012). Internationally, there is also a push to critically examine public education to better meet the needs of learners in a world that is vastly different from the nineteenth or twentieth centuries (Ananiadou and Claro, 2009; OECD, 2010; Partnership for 21st Century Skills, 2011; Schleicher, 2012). Because of this widespread adoption and focus, I am proposing that we consider revamping our courses to align with these initiatives.

PRINCIPLES OF TWENTY-FIRST CENTURY LEARNING

There are numerous frameworks for twenty-first century learning (see Dede, 2009 for a comparative analysis). As a sample, I am referring to two western provinces in Canada (British Columbia and Alberta) which have outlined the principles of twenty-first century learning by listing the skills and dispositions that citizens will need in order to thrive in a knowledge-based society: (1) collaboration and leadership, (2) critical thinking and problem solving, (3) creativity and innovation, (4) social responsibility; cultural, global, and environmental awareness communication, (5) digital literacy, and (6) lifelong learning, self-direction, personal management (adapted from Premier's Technology Council, 2010; Alberta Education, 2011).

These documents further identify how the education system must change. Our education systems must move away from: (a) learning information to learning to learn, (b) data consumption to discovery, because content is changing rapidly, (c) "one-size-fits-all" to tailored learning (project-based), (d) testing to assess to assessing to learn, (e) classroom to lifelong learning and learning for authentic purposes, (f) teacher as lecturer to teacher as guide, and (g) passive to active learners (adapted from Premier's Technology Council, 2010; Alberta Education, 2011). Others have framed these changes in terms of: (a) Ways of Thinking (creative, innovative, critical, decision-making, learning to learn/metacognitive), (b) Ways of Working (communication, collaboration), and (c) Tools for Working (information literacy, ICT literacy) (Binkley et al., 2012).

Nowhere in any of these visions of education does it focus on just acquiring knowledge such as theories, theorems, or basic facts. Rather, the focus is on *thinking* and *working* differently, which is a challenge for introductory educational psychology courses, which continue to be theory-laden.

"I'll make it fit"

As you review the first list above, you could argue that you can do all of those things within your current educational psychology courses. For example, you might say that your TCs already work collaboratively on projects that you assign, that they must communicate effectively with peers, and that they think critically and solve problems or questions that you pose. Furthermore, you may say, as I have, that TCs must already be self-directed learners to be admitted into a teacher education program. They must already be concerned citizens who want to make the world a better place, particularly for children. I could stop right there and not really change anything in the way that I teach my introductory educational psychology courses, but there is more to consider.

Doing it differently

The list on the teaching and learning process is at the heart of change in the twenty-first century framework. This is where I am really challenged, beginning with the very first tenet—from learning information to learning to learn. Does it mean that theory is no longer the driving force for courses in child development? Maybe, rather than being consumers of knowledge, my TCs need to be discoverers of knowledge (tenet #2). What if our TCs develop their own theories of why and how children and youth develop and learn? Now we are getting somewhere!

Tenet #3 talks about personalized learning. So, if one-size curriculum doesn't "fit all," maybe that means that I need to allow my students to pose the problems and create their own projects that are relevant to their assigned practica. Maybe it means that the course learning outcomes have only suggested topics. For example, maybe some TCs will explore language development because they are placed in classrooms of multilingual learners, while other TCs will focus on motivational theory because they are particularly challenged by students who are turned-off school.

When I allow my TCs to determine their own projects, I am fostering learning for authentic purposes (tenet #5), and facilitating self-directed learning. I am developing the "habits of the mind," which I hope will carry forward into their future careers. This also relates to tenet six. If I support my TC's self-selected projects, I am surely being a guide and no longer the "sage on the stage." In the end, this helps me to achieve the seventh tenet—that my students are active participants and not passive receptacles.

My introductory educational psychology course will look distinctly different now. I have changed the way that I teach my course and the way that my TCs are "thinking" (Binkley et al., 2012). But I still wonder how else I need to re-structure the course to promote new "ways of working"? One option might be to create professional learning communities (PLC), which would include both TCs and practicing teachers. The purpose of the PLCs is to promote collaborative problem solving and action research. TCs could help analyze situations and solve problems that are most pressing for classroom teachers. By doing this, I establish the expectation that teachers continually reflect on their practice, make adjustments, and try new strategies or approaches. It also reinforces the notion

that collective examination and conversation can be highly effective to improve educational practice.

I could go on believing that what I am currently doing can "fit" into the principles of twenty-first century learning. A much better fit is to look at the discipline "anew." The first step is accepting that our discipline must evolve in order to remain relevant for teaching and learning in current and future educational contents. That does not mean "tossing the baby out with the bath water," but it should spur us to critically examine how our discipline can continue to make significant contributions to education. Utilizing the principles from the twenty-first century learning literature is only one way to reframe; I am sure that there are many others. I want to begin the dialog.

> "We need to rethink how to transform public education to ensure relevancy for today's modern learner" (C21 Canada, 2012, p. 4).

REFERENCES

Alberta Education. (2011). *Framework for Student Learning: Competencies for Engaged Thinkers and Ethical Citizens with an Entrepreneurial Spirit*. Available online at: http://education.alberta.ca/department/ipr/curriculum.aspx (Accessed March 2014).

Ananiadou, K., and Claro, M. (2009). *21st Century Skills and Competences for New Millennium Learners in OECD Countries. OECD Education Working Papers*, No. 41 (OECD Publishing). doi: 10.1787/218525261154

Berliner, D. C. (2012). "Educational psychology: searching for essence throughout a century of influence," in *Handbook of Educational Psychology, 2nd Edn.*, eds P. A. Alexander and P. H. Winne (New York, NY: Routledge), 3–28.

Berliner, D. C., and Calfee, R. C. (2004). "Introduction to a dynamic and relevant educational psychology," in *Handbook of Educational Psychology* eds D. C. Berliner and R. C. Calfee (New Jersey, NJ: Lawrence Erlbaum Assoc., Inc.), 1–11.

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M., et al. (2012). "Defining twenty-first century skills," in *Assessment and Teaching of 21st Century Skills*, eds P. Griffin, B. McGaw, and E. Care (Netherlands: Springer), 17–66.

Boudreault, F.-A., Haga, J., Paylor, P., Sabourin, A., Thomas, S., and van der Linden, C., (2012/2013). *Future tense: Adapting Canadian Education Systems for the 21st Century*. Ontario: Action Canada.

C21 Canada. (2012). *Shifting Minds: A 21st Century Vision of Public Education for Canada. Canadians for 21st Century Learning and Innovation*. Available online at: http://www.c21canada.org/wp-contenet/uploads/2012/02/C21-Canada-Shifting_Minds.pdf (Accessed March 2014).

Dede, C. (2009). *Comparing Frameworks for 21st Century Skills*. Available online at: http://watertown.k12.ma.us/dept/ed_tech/research/pdf/ChrisDede.pdf (Accessed March 2014).

Dunleavy, J., Milton, P., and Willms, J. D. (2012). *Trends in Intellectual Engagement. What did You do in School Today? Research Series Report Number Three*. Canadian Education Association. Available online at: www.actioncanada.ca/archive/task-force-policy-projects-archive

Friesen, S., and Jardine, D. (2010). *21st Century Learning and Learners*. Available online at: http://education.alberta.ca/media/1087278/wncp%2021st%20cent%20learning%20(2).pdf (Accessed March 2014).

OECD. (2010). "Investing in human and social capital: new challenges. Issues for discussion," in *OECD Education Ministerial Meeting* (Paris).

Partnership for 21st Century Skills. (2011). *Framework for 21st Century Learning*. Available online at: http://www.p21.org/our-work/p21-framework (Accessed April 2014).

Premier's Technology Council. (2010). *A Vision for 21st Century Education*. British Columbia: Government of British Columbia. Available online at: http://www.gov.bc.ca/premier/attachments/PTC_vision%20for_education.pdf (Accessed March 2014).

Schleicher, A. (ed.). (2012). *Preparing Teachers and Developing School Leaders for the 21st Century: Lessons from around the World*. OECD publishing. Available online at: www.oecd.org/site/eduistp2012/49850576.pdf

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Predictors of depression, stress, and anxiety among non-tenure track faculty

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Nationwide in the United States, 70% of faculty members in higher education are employed off the tenure-track. Nearly all of these non-tenure-track (NTT) appointments share a quality that may produce stress for those who hold them: contingency. Most NTT appointments are contingent on budget, enrollment, or both, and the majority of contingent faculty members are hired for one quarter or semester at a time. Significant research has investigated the effects of contingency on teaching, students, departments, colleges, and universities; however, little research has focused on the psychological experiences of NTT faculty. The current study examined perceptions of workplace stressors and harm, organizational commitment, common coping mechanisms, and depression, anxiety and stress among NTT faculty using a longitudinal design that spanned 2–4 months. Results indicate that NTT faculty perceive unique stressors at work that are related to their contingent positions. Specific demographic characteristics and coping strategies, inability to find a permanent faculty position, and commitment to one's organization predispose NTT faculty to perceive greater harm and more sources of stress in their workplaces. Demographic characteristics, lower income, inability to find a permanent faculty position, disengagement coping mechanisms (e.g., giving up, denial), and organizational commitment were associated with the potential for negative outcomes, particularly depression, anxiety, and stress. Our findings suggest possibilities for institutional intervention. Overall, we argue that universities would be well-served by attending to the needs of NTT faculty on campus in order to mitigate negative outcomes for institutions, students, and faculty.

Keywords: contingent faculty, stress, depression, organizational commitment, temporary workers

INTRODUCTION

Over the past four decades, colleges and universities in the US have seen an increase in the number of non-tenure-track (NTT) faculty. Nationwide, 70% of faculty members in higher education are employed off the tenure-track (Curtis and Thornton, 2013). Most NTT appointments are contingent on budget, enrollment, or both, and the majority of NTT faculty are hired for one quarter or semester at a time. Contingent NTT faculty are paid less than assistant professors (Ehrenberg and Zhang, 2005), often do not receive adequate health and retirement benefits (CAW, 2012), are not typically represented in university governance, and academic freedom among such faculty is not protected (Baldwin and Chronister, 2001; AAUP, 2013). For these reasons, the relation of tenure-track and NTT faculty on college campuses has been referred to as a faculty "caste system" (Gappa and Leslie, 1993). In addition to the issues of inequality that arise from differential access to resources and power, NTT faculty are also disproportionately female (Bland et al., 2006; Gappa et al., 2007; Curtis, 2014) and are more likely than tenured or tenure-track faculty to be Black/African American, Hispanic/Latino, or American Indian than to be Asian or White (Bradburn et al., 2002; Curtis, 2014); thus, issues facing NTT faculty also have implications for gender and race equality.

There are a variety of explanations for these trends in higher education. According to some, declines in federal and state education spending, competition from virtual and for-profit colleges, increases in tenured/tenure-track faculty salaries, and greater demand for services to accommodate a diverse student population have forced many institutions to freeze hiring for permanent positions and to hire temporary employees instead (Gappa and Leslie, 1993; Baldwin and Chronister, 2001; Murphy, 2009). However, the American Association of University Professors (AAUP, 2014) claims that the hiring of contingent faculty is not economically necessary, but rather, is the result of a choice to prioritize investment in technology and facilities over investment in instruction. Bok (2006) presents another reason why universities hire NNT faculty: NTT hires may signal the universities' commitment to undergraduate education amid criticism of a research-focused academic culture, thus attracting undergraduate enrollment. There are also important disciplinary differences in the number and nature of NTT faculty on US campuses. In some disciplines (e.g., political science, psychology, philosophy),

at Bachelor's degree granting and higher institutions, the majority of NTT faculty hold terminal degrees whereas this may not the case in some other disciplines (e.g., English, math). Moreover, faculty in the liberal arts are more likely to desire full-time work, and to piece together a variety of teaching appointments, whereas business, nursing, and professional faculty are more likely to take on a single course to supplement a full-time job (Lewis, 2012).

Many questions have been raised about the impact of NTT faculty on institutions, tenured/tenure-track faculty, and students, and research in the field of education has begun to address these questions. Although some research examines contingency from the perspective of NTT faculty—their motivations for choosing the work, perceptions of the academic environment, and factors that affect their job satisfaction and organizational commitment—less research has focused on the psychological well-being of NTT faculty. Given the financial pressures that academic institutions have faced since the economic recession of 2008, we believe it is particularly important to examine the psychological impact of the trend toward contingent faculty labor in order to anticipate and mitigate harm to NTT faculty, as well as to institutions and to students.

In an effort to fill this gap, we examine perceptions of workplace stressors and harm, organizational commitment and identification, common coping mechanisms, and the occurrence of depression, anxiety, and stress among NTT faculty using a longitudinal design that spanned 2–4 months. In this research we are examining both "stressors" which are events or conditions which are perceived as stressful, and "stress," which is the psychological and physiological reaction to a stressor or stressors. We propose that NTT faculty from some demographic groups—specifically, those with lower household incomes and those who desire a tenure-track position—will be more likely to perceive sources of stress (stressors) in the workplace and to report harm to themselves and colleagues in the wake of the 2008 recession. We also expect that commitment to and identification with one's institution and reliance on maladaptive coping mechanisms will predispose NTT faculty to higher levels of depression, anxiety, and stress. Our findings indicate that NTT faculty's experiences of stressors and depression, anxiety, and stress do vary based on demographic characteristics, coping mechanisms, and organizational identification and commitment. More broadly, they suggest a need for further research to examine the broad psychological impact of labor practices in higher education.

The increase in contingent faculty positions has had an impact on universities and students. As noted above, research has begun to examine the effects of contingent faculty hiring on institutions of higher learning. Many see the increase in temporary faculty positions as a threat to academic freedom and tenure, which many professors and universities consider crucial for the development of new knowledge (Chait, 1997; Baldwin and Chronister, 2001; AAUP, 2013). An increase in the number of NTT faculty, and corresponding decrease in the number of tenured faculty, means that there are fewer faculty to participate in shared governance and that more power may shift to administrators (Baldwin and Chronister, 2001; Bradley, 2004; AAUP, 2013). Increased reliance on NTT faculty also creates stratification among faculty, which raises concern over the ability for faculty to build collegial relationships (Thompson, 2003; AAUP, 2013) and the potential for stigmatization or disrespect of NTT faculty (Barker and Christensen, 1998; AAUP, 2013).

Research has also examined the impact of contingent faculty on time spent with students and on faculty activities which are likely to affect student learning. The results generally reveal that the activities of TT and full-time NTT faculty are likely to be more advantageous for student learning than are the activities of part-time NTT faculty. Part-time NTT faculty spend less time interacting with students (Baldwin and Chronister, 2001; Umbach, 2007) and less time preparing for class (Umbach, 2007) than their TT counterparts. Full-time NTT faculty, however, spend more time preparing for class than TT faculty (Umbach, 2007). Part-time contingent faculty are less likely to engage in student-centered and learning-centered classroom activities that have been shown to promote student learning (Umbach, 2007; Baldwin and Wawrzynski, 2011); TT and NTT full-time faculty do not differ in regard to frequency of use of these activities (Umbach, 2007). NTT faculty tend to give higher final grades than TT faculty, possibly in response to pressure to show strong course evaluations in order to secure a future teaching appointment (Sonner, 2000; Johnson, 2011). The negative outcomes which are sometimes associated with part-time NTT positions occur not because part-time NTT faculty don't care about students—to the contrary, evidence suggests that NTT faculty are dedicated, highly qualified teachers (Gappa and Leslie, 1993; Baldwin and Chronister, 2001). Despite their best intentions, however, NTT faculty—particularly those who are part-time—may not have the resources they would need to create a good educational experience for students, such as an on-campus office to meet with students, material resources to facilitate classroom activities, and reasonable course loads that would give them time to grade in-depth exams and assignments (Curtis and Jacobe, 2006; Jaeger et al., 2007).

Previous research has also examined the effects of contingent faculty hiring on the experiences of faculty themselves. One question of interest is, why do faculty choose or accept temporary work? Like many of their TT counterparts, faculty employed off the tenure-track have a strong intrinsic motivation to teach (Dutton, 2009; Lewis, 2012). Academic work successfully satisfies these desires—in general, research shows high job satisfaction among both TT and NTT faculty. However, satisfaction also depends to some extent on demographic and individual difference characteristics, including age and marital status (Schulz, 2009), academic discipline (Palmer, 2002), level of compensation and desire for full time employment (Lewis, 2012), as well as psychological factors like the level of stress associated with the work (Hagedorn, 2000).

Despite the joys of teaching and generally high levels of satisfaction among NTT faculty, temporary academic work can be associated with hardship. As mentioned earlier, NTT faculty are paid less than TT faculty and often receive few or no health or retirement benefits (CAW, 2012). Also, the contingent nature of many NTT positions puts faculty at risk for chronic unemployment or underemployment, and in the US, the unpredictable nature of enrollments makes it extremely difficult for NTT faculty

to receive support from unemployment insurance (NFM, 2012). Moreover, many NTT faculty are not permitted to participate in university governance to the level they would prefer (Berret, 2008). Although some faculty do choose contingency, with all of its costs, an estimated 50% (CAW, 2012) use part-time or temporary teaching as a substitute for full-time work, and would prefer a full-time or tenure-track position. Tenure-track positions include many of the benefits of faculty work without the financial risks and stigma of many NTT positions.

Another question of interest is the impact of contingency on organizational commitment and identification among faculty. Organizational commitment is defined as an employee's level of dedication to a specific organization (Meyer and Allen, 1991; Murphy, 2009). According to theories of commitment developed in organizational psychology, commitment develops when individual employees feel valued by an organization (Meyer and Allen, 1991) and is a key determinant of retention and performance (Mowday et al., 1982; Rhoades and Eisenberger, 2002). A related concept, organizational identification, is often used interchangeably with organizational commitment, but is a distinct characteristic defined as the perception of unity with or belonging to an organization (Ashforth and Mael, 1989). Employees who are high in organizational identification define themselves, in part, in terms of the organization, and are likely to experience the group's victories and setbacks as their own (Ashforth and Mael, 1989). Once an individual identifies as a member of the organization, there is potential for commitment to develop.

Given the importance of retaining a dedicated and talented faculty, organizational commitment and identification should be of interest to academic institutions. Organizational commitment, in particular, offers rewards to employees in the form of intrinsic motivation and satisfaction (Mowday et al., 1982; Koys, 1988). Unfortunately, the contingent nature of many NTT academic positions sends an implicit message to NTT faculty that they are not valued by the organization. In doing so, universities may limit the depth of the exchange between employer and employee that is so important for the development of commitment. In line with this, studies of temporary work arrangements in non-academic contexts find that contingent workers are less committed and less effective than their permanent counterparts (Blau, 1964; McGinnis and Morrow, 1990; Pearce, 1993; Kallenberg, 2000; Liden et al., 2003; Connelly and Gallagher, 2004; Kraimer et al., 2005).

Rather than accepting lower commitment of contingent employees as a given, research has aimed to identify antecedents of organizational commitment that can be strengthened to increase levels of dedication among employees. Predictors of organizational commitment identified in the research include recognition, support, compensation, and participation in shared governance (Wayne et al., 1997; Kacmar et al., 1999; Murphy, 2009). Characteristics of individual employees are also associated with organizational commitment. Age and marital status predict organizational commitment such that older employees and those who are married show higher levels of commitment (Kacmar et al., 1999). Women also demonstrate higher levels of organizational commitment than men (Mathieu and Zajac, 1990; McFarlin and Sweeney, 1992).

Given that organizational commitment is a psychological state, it is more than a desirable end goal for faculty and institutions. Organizational commitment is also likely to shape employees' reactions to workplace situations. Although examinations of the moderating role of organizational commitment are not as common in the literature, Groff (2012) found initial evidence that organizational commitment can buffer the effect of a negative workplace event on employee turnover, likely because dedication to the organization motivates committed employees to interpret new workplace developments in more positive ways. In the case of NTT faculty, however, organizational commitment may operate differently than it operates for permanent employees since NTT faculty may be committed to an organization that is not committed to them. Possibly, among NTT faculty organizational commitment may not operate as a buffer of the effects of negative workplace events, but rather, feeling commitment to an organization that fails to reciprocate the commitment may lead to negative reactions such as depression, anxiety, or stress.

The many challenges of contingent work also raise the possibility that NTT faculty experience high levels of stress, anxiety, and depression. The conventional wisdom is that job insecurity that stems from temporary work status can contribute to a variety of health problems, and indeed, several studies conducted in non-academic workplace settings have found that temporary employees are more likely to have health problems (Benavides and Benach, 1999; Benavides et al., 2000). Stress at work is also associated with temporary work status in non-academic settings, such that temporary workers report more stress than permanent employees (Benavides et al., 2000). Higher levels of stress are also associated with lower job satisfaction (Hagedorn, 2000), organizational commitment (Meyer and Allen, 1997), and employee retention (Barnes et al., 1998).

To our knowledge, depression and anxiety have not been studied in the temporary faculty population. Studies comparing the stress levels of part-time and full-time faculty find that part-time faculty experience less stress (Gappa and Leslie, 2002; Outcalt, 2002). This difference may be explained by occupational role overload experienced by full-time faculty, a feature of academic work that full-time NTT faculty are also likely to experience (Barnes et al., 1998; Lease, 1999). However, the nature of stressors that NTT faculty experience may be different and may be high under certain circumstances, such as an economic recession. Stress over the stigma and status of their rank may also be a unique stressor for NTT faculty. Given the possible link between workplace stressors and other important personal and institutional outcomes among NTT faculty, understanding the impact of contingency on stress, depression, and anxiety among this population is an important goal.

The coping mechanisms that NTT faculty use may also affect both their stress levels and other psychological outcomes, including anxiety and depression. The current study uses a widely used measure of coping, the COPE scale (Carver et al., 1989), which assesses a diverse range of 15 coping mechanisms. Numerous researchers have produced models of the structure of coping, which involves categorizing coping mechanisms into a relatively small number of general categories (Connor-Smith and Flachsbart, 2007). One category system involves classifying coping

mechanisms as involving either *engagement* with or *disengagement* from the stressor, i.e., either purposefully undertaking to manage the stressor and/or its related emotions, or distancing oneself from the stressor and/or emotions. For instance, the COPE scales "planning" and "active coping" are classified as engagement mechanisms whereas "denial" and "behavioral disengagement" (giving up) are classified as disengagement mechanisms. Although it is not possible to claim that a particular coping mechanism is either functional or dysfunctional in all contexts, roughly speaking, use of engagement coping mechanisms tends to be associated with more positive life outcomes, including better physical and mental health, whereas use of disengagement coping mechanisms tends to produce less desirable outcomes (Compas et al., 2001).

Research on the impact of contingent faculty in higher education has tended to focus on the impact of contingency on universities and on students, with less attention paid to the experiences and well-being of faculty. As described above, previous literature leaves several unanswered questions about contingent faculty experiences of stress and the impact of contingency on longer-term health outcomes such as depression and anxiety. The psychological literature on stress and coping suggests new ways of understanding the experience of contingency, and points to questions that are important for the future of faculty well-being:

(1) What are the key workplace stressors for contingent faculty?

This is a particularly important question in the wake of the 2008 recession, which continues to impose a financial strain on many universities. NTT faculty may report that their primary stressors are those that are related to financial security (e.g., contingency, low pay, no health insurance). The distinct nature of faculty work and the high levels of job satisfaction among NTT faculty may further bolster the idea that when NTT faculty identify primary workplace stressors, the stressors would tend to be unrelated to their actual work tasks (e.g., lecturing, interacting with students), since the work itself is experienced as rewarding.

(2) How do NTT faculty cope with stress related to contingency? To what extent do they use adaptive or maladaptive coping strategies, and what are the broader health consequences of these strategies?

Previous research links temporary employment to negative health outcomes. Again, because this research is conducted in non-academic settings, it is unclear whether contingent employment in academia is a risk factor for health. The psychological literature on stress and coping indicates that not only stress level, but also the method for coping with stress can put employees at risk for negative health outcomes. In particular, disengagement coping mechanisms such as behavioral disengagement (giving up) and denial are likely to be linked to negative health outcomes such as anxiety and depression (Allman et al., 2009; Gandy et al., 2012; Li et al., 2014).

(3) What are sources of individual variation in contingent faculty experiences of stress?

Previous research indicates that contingent faculty may experience the workplace differently based on demographic factors. Gender influences perceptions of stressors, in both work and non-work environments. Results of a large meta-analysis reveal that women report more stressors than men across many life domains (Davis et al., 1999). Age is also related to perceived stressors. Older people report significantly lower levels of daily hassles stressors (minor stressors), such as getting stuck in traffic or running late for an appointment, than do younger people (Aldwin, 2011). It is not clear whether older people experience fewer of these types of stressors or whether they are simply less bothered by such potentially annoying events. Aldwin (2011) states that the latter interpretation may be most likely. Age may not be related to absolute amount of major stressors, such as death of a loved one or divorce; research results are inconsistent (Aldwin, 2011).

In addition, the psychological literature on stress and coping indicates systematic variation in how individuals cope with stress. In a meta-analysis on sex comparisons in coping, Tamres et al. (2002) report that women engage in more positive self-talk (encouraging oneself), seeking social support, and rumination than do men. Coping may also change with age, such that older adults may utilize more efficient coping mechanisms, those which conserve resources, appear to be better at regulating negative emotions, and may be less likely to appraise situations as highly stressful (Aldwin, 2011). Therefore, we might expect that NTT experiences of stress and coping will vary based on these individual differences.

The current study involves investigating perceived workplace stressors, perceived workplace harm, coping, organizational commitment and identification, and well-being outcomes related to these variables (depression, anxiety, and stress) among contingent faculty members. A first goal is to describe common stressors and coping mechanisms for contingent faculty. We will also examine the degree of organizational commitment among contingent faculty, and investigate whether commitment correlates with age and gender, as shown in earlier research. Next, we will predict perceptions of workplace stressors and harm, depression, anxiety, and stress from general demographic variables, situational variables (i.e., total family income and desire for permanent faculty work), and individual coping mechanisms, with the general expectation that variables at each of these psychological levels will partially explain the psychological experiences of NTT faculty. In predicting depression, anxiety, and stress, which were measured at time 2, we will utilize measures of harm, stressors, coping mechanisms, organizational commitment and organizational identification which were taken at time 1, in order to determine if these presumably stable personal qualities (i.e., coping mechanisms, identification, and commitment) and perceived situational factors (i.e., perceived stressors and harm), which may or may not be stable, precede the psychological reactions of depression, anxiety, and stress. Lastly, we will investigate the interaction between organizational commitment and stressors/harm as predictors of depression, anxiety, and stress. This last set of analyses will address the question: Does commitment buffer the effects of stressors and harm on depression, anxiety, and stress, as might be predicted from research on other types of workers, or will we find that among contingent faculty, organizational commitment

fails to operate as a buffer? We predict the latter result, given that organizational commitment may operate as a protective factor only among those employees who feel job security in their positions.

MATERIALS AND METHODS

PROCEDURE

The procedures of this study were approved by the Institutional Review Board of California State University, East Bay. We solicited participants for an online two-part study on experiences of contingent faculty between October 2011 and April 2012. Solicitations were sent to four listservs: adj-l (which focuses on adjunct faculty issues), the Society for Personality and Social Psychology, the Society for the Psychological Study of Social Issues, and the Society for the Teaching of Psychology. All lecturers at a medium-sized public university in the United States were invited to participate. Additionally, the New Faculty Majority, an advocacy organization for contingent faculty, posted the first solicitation on their website. Prospective participants were told that, for the purposes of this survey, contingent faculty members were defined as any instructional or research faculty who work off the tenure track at institutions of higher education, such as lecturers, adjunct faculty, post-docs, and graduate students.

The survey was through Google docs. Once at the Google docs website, participants gave their informed consent. They provided an email so that we may send them a reminder email about participating in Part 2, and were asked to create a unique ID number so that we could match Part 1 and Part 2 surveys. Next, participants completed a series of questionnaire measures in the following order: organizational commitment, organizational identification, perceptions of stressors, perceptions of harm, coping, and a demographic information form. Immediately prior to the questionnaire about perception of stressors, participants were asked an open-ended question: Which aspects of your job do you find most stressful? If possible, list and describe at least two aspects. Additionally, participants were invited to make comments about the survey or anything else. Lastly, participants were thanked, given contact information of the researchers, and were invited to include their name, email address, and phone number if they were interested in participating in an optional drawing for one of five $100 gift cards redeemable at Powells Books, an independent bookseller headquartered in Portland Oregon, which sells books both onsite and online.

Two to four months after participation in the Part 1 survey, between January and July of 2012, participants received an email inviting them to complete the Part 2 survey. Participants completed the following questionnaire measures: perceptions of stressors, perceptions of harm, coping, depression, anxiety, and stress, organizational commitment, and organizational identification. Next, the participants were thanked, provided with the researchers' contact information, and were invited to enter their name, email address, and phone number if they would like to participate in the drawing. Lastly, the participants were brought to a debriefing page that explained that the study involved examining relationships between stress and coping strategies and contingent faculty health outcomes and workplace commitment.

PARTICIPANTS

Part 1 survey

There were 199 participants (129 women, 67 men, and three who did not report a gender) in the Part 1 survey. Demographic characteristics which are expressed as percentages of the sample (e.g., racial/ethnic background, highest education level) are presented in **Table 1**. Age of participants ranged from 24 to 85 with a mean of 47.9. Family incomes ranged from under $10,000 per year to over $150,000 per year with the mean income in the $50,000–59,000 range. Among those who are married, most (59.8%) reported that their spouse worked 40 or more hours per week in paid employment. Paid hours of work per week varied widely, ranging from 2 to 60, with many reporting that they did not know the answer. Average number of years working in higher education in a temporary teaching and/or research position was reported as 10.7 (range from 1 to 50), with 87.4% of the sample responding. In response to the question, "How many years have you been in your current job that you consider your primary job?" number of years ranged from 0.25 to 44, with a mean of eight. Five percent did not respond to the question, 2.5% were retired, and 1% were unemployed. In response to the question, "At how many institutions of higher education do you typically work during any one "term" (semester or quarter)"? the mean was 1.50 and the number ranged from one to five. Nine percent of people did not respond to the question.

Part 2 survey

Ninety participants (54 women, 35 men, and one who did not identify a gender) participated in both the Part 1 and Part 2 surveys. Demographic characteristics which are expressed as percentages of the sample (e.g., racial/ethnic background, highest education level) are presented in **Table 2**. Age ranged from 25 to 79 with a mean of 49.4. Family incomes ranged from $10,000 to over $150,000 per year, with the mean income in the range of $60,000–69,999. Among those who are married, most (68.8%) reported that their spouse worked 40 or more hours per week in paid employment. Paid hours of work per week varied widely, ranging from 2 to 60, with many reporting that they did not know the answer. Average number of years working in higher education in a temporary teaching and/or research position was reported as 12, with 85.5% of the sample responding. In response to the question, "How many years have you been in your current job that you consider your primary job?" number of years ranged from 0.25 to 44, with a mean of 8.3. Two percent did not respond, 3.3% were retired, 1.1% was unemployed. In response to the question, "At how many institutions of higher education do you typically work during any one "term" (semester or quarter)"? the mean was 1.53 and the number ranged from one to five.

MEASURES

The Affective Commitment Scale (ACS; Allen and Meyer, 1990) was used to measure organizational commitment to a university where one works, in both the Part 1 and Part 2 surveys. The instructions regarding which university to choose were, "Please respond to the following items about the college or university where you work. If you work at more than one institution, respond to the items in regard to the institution about which

Table 1 | Participants' demographic characteristics for Part 1 of the survey.

Demographic variable	% in survey sample
RACIAL/ETHNIC BACKGROUND	
Asian/Asian American	2.0
Black/African American	3.5
Latino/Hispanic	3.0
Native American	0.5
White/Caucasian	81.4
Multiracial	3.0
Other	1.0
Missing	5.5
CITIZENSHIP	
United States	91.5
Other country	6.0
Missing	2.5
HIGHEST EDUCATION LEVEL	
Doctorate	40.7
Juris doctor	1.0
ABD (all but dissertation)	15.1
Master's degree	38.7
Bachelor's degree	3.5
Missing	1.0
FIELD IN WHICH HIGHEST DEGREE WAS EARNED	
Art, film, theater, or music	7.5
Anthropology	3.5
Biology	2.0
Business, economics, or management	3.0
Education	7.0
English, literature, creative writing, or language	20.5
History	6.5
Psychology, counseling, or social work	18.5
Other	27.5
Missing	4.0
MARITAL/RELATIONSHIP STATUS	
Married	47.7
Unmarried and cohabiting	8.0
Divorced	11.1
Single, never married	26.1
Separated	1.0
Widowed	4.0
Missing	2.0
CHILDREN	
Yes	48.2
No	48.7
Missing	3.0
TYPE OF CONTINGENT POSITION	
Adjunct/contingent faculty or instructor	84.9
Teaching assistant or graduate student instructor	6.5
Research associate or post-doc	4.0
Other	2.0
Missing	2.5
LOCATION OF PRIMARY JOB	
University that grants graduate degrees	50.8
Four-year college	16.6
Community college	23.1
Missing	9.5
RECEIVE BENEFITS THROUGH OWN EMPLOYMENT, SPOUSES' EMPLOYMENT, OR OTHER SOURCE?	
No	29.1
Health insurance only	18.1
Retirement only	8.0
Both health insurance and retirement	38.2
Health, retirement, and other benefit	2.0
Don't know or sometimes	2.0
Missing	2.0

you feel most positively." The ACS consists of eight items, each of which is rated from 1 (strongly agree) to 7 (strongly disagree). Total scale scores range from 7 to 56. The eight items were modified to replace the word "organization" with "college/university." An example of an item is: "I would be very happy to spend the rest of my career with the college or university where I work now." Half of the items are reverse scored. Allen and Meyer (1990) report an alpha of 0.87 for the ACS. As validity evidence they report that the ACS correlates significantly with the Organizational Commitment Questionnaire (Mowday et al., 1979). Alphas in the current study were in the 0.80 s for the Part 1 and Part 2 surveys and for the combined data set.

The Organizational Identification Questionnaire (OIQ; Mael and Ashforth, 1992) was used to measure organizational identification with a university where one is employed, in both the Part1 and Part 2 surveys. The instructions regarding which university to choose were, "Please respond to the following items about the college or university where you work. If you work at more than one institution, respond to the items in regard to the institution about which you feel most positively." The OIQ consists of six items, each of which was rated from 1 (strongly agree) to 7 (strongly disagree) in the current study. Total scale scores range from 6 to 42. The six items were modified to use the expression "college/university" or a relevant variant. An example of an item is "This college/university's successes are my successes." Mael and Ashforth (1992) report coefficient alphas in earlier studies, all in the 0.80 s. Alphas in the current study were in the 0.80 s for the Part 1 and Part 2 surveys and for the combined data set.

The researchers developed a questionnaire to measure stressors, called "Contingent Faculty Stressors Questionnaire (CFSQ)," which was used in both the Part 1 and Part 2 surveys. The CFSQ consists of five items which ask the following: whether overall stress level has changed since the economic downturn of 2008, whether job security has decreased, whether income has decreased, whether workload has increased, and whether medical benefits were lost at some point since 2008. The Part 2 survey asked respondents to rate which of the same aspects of their work have changed since their completed the Part 1 survey and to rate the degree of change. Higher scores indicated more stress (e.g., overall stress level changing for the worse, job security decreasing, etc.). All variables ran from 0 to 1 such that total scores on the

Table 2 | Participants' demographic characteristics for Part 2 of the survey.

Demographic variable	% in survey sample
RACIAL/ETHNIC BACKGROUND	
Black/African American	3.3
White/Caucasian	85.6
Multiracial	3.3
Other or missing	7.7
CITIZENSHIP	
United States	94.4
Other country	4.4
Missing	1.1
HIGHEST EDUCATION LEVEL	
Doctorate	46.6
ABD (all but dissertation)	18.9
Master's degree	31.1
Bachelor's degree	3.3
FIELD IN WHICH HIGHEST DEGREE WAS EARNED	
Art, film, theater or music	6.6
Anthropology	5.5
Biology	3.3
Business, economics, or management	4.4
Education	9.9
English, literature, creative writing, or language	14.4
History	6.7
Nursing or health sciences	3.3
Philosophy	3.3
Psychology or counseling	21.0
Other	20.9
MARITAL/RELATIONSHIP STATUS	
Married	52.2
Unmarried and cohabiting	5.6
Divorced	13.3
Single, never married	23.3
Separated	1.1
Widowed	3.3
Missing	1.1
CHILDREN	
Yes	47.8
No	50.0
Missing	2.2
TYPE OF CONTINGENT POSITION	
Adjunct/contingent faculty or instructor	86.7
Teaching assistant or graduate student instructor	5.6
Research associate or post-doc	4.4
Other	3.3
LOCATION OF PRIMARY JOB	
University that grants graduate degrees	56.7
Four-year college	15.6
Community college	20.0
Missing	7.8
RECEIVE BENEFITS THROUGH OWN EMPLOYMENT, SPOUSES' EMPLOYMENT, OR OTHER SOURCE?	
No	32.2
Health insurance only	18.9
Retirement only	6.6
Both health insurance and retirement	40.0
Health, retirement, and other benefit	2.2

stressor scale ranged from 0 to 5. Alphas in the current study were 0.67 for the time 1 survey, 0.67 for the time 2 survey, and 0.70 for the combined data set. A factor analysis, using a Maximum Likelihood Analysis with direct oblimin rotation revealed that all stressor items loaded on a single factor.

The researchers developed a questionnaire to measure perceived harm observed in the workplace, called "Contingent Faculty Harm Scale (CFHS)," which was used in both the Part 1 and Part 2 surveys. The CFHS consists of four items which ask whether the participant has observed the following: harm occurring to colleagues, for instance, loss of job or loss of income; harm occurring to students, for instance, increased tuition or decreased access to classes; people at work treating one another more poorly than they used to; and personally having less freedom to speak his/her mind in the classroom and/or with colleagues and administrators. The Part 2 survey asked respondents to rate which of the same aspects of their work have changed since their completed the Part 1 survey and to rate the degree of change. Each of the four items is rated on a four-point scale where 0 = not at all, 1 = somewhat, 2 = moderately, and 3 = dramatically. Scores on the Harm questionnaire range from 0 to 12. Alphas in the current study were 0.69 for the time 1 survey, 0.74 for the time 2 survey, and 0.72 for the combined data set. A factor analysis using a Maximum Likelihood Analysis with direct oblimin rotation revealed that all harm items loaded on a single factor.

The COPE scale (Carver et al., 1989) was used to measure coping mechanisms in both the Part 1 and Part 2 surveys. The COPE scale measures 15 coping mechanisms: active coping, planning, suppression of competing activities (putting aside other activities and concerns in order to focus on the stressor), restraint coping (waiting till the right time), seeking instrumental support, seeking emotional support, positive reinterpretation and growth, acceptance, turning to religion, venting, denial, behavioral disengagement (giving up), mental disengagement, alcohol and drug disengagement (also called "substance use"), and use of humor. The COPE scale includes 60 items; each scale is assessed by four items. Examples of items include "I get upset and let my emotions out" and "I make a plan of action." Items are rated on a four-point scale: 1 = I usually don't do this at all, 2 = I usually do this a little bit, 3 = I usually do this a medium amount, and 4 = I usually do this a lot. Scores on each scale range from 4 to 16. The COPE scale possesses acceptable reliability and validity; Carver et al. (1989), utilizing a sample of 978 reported alphas ranging from the 0.60 to 0.90 s for all of the scales except mental disengagement, with an alpha of 0.45. In the current study, alphas ranged in the 0.70 to the 0.90 s for all scales for both Part 1 and Part 2 surveys, and for the combined data set, with the exception of mental disengagement, denial, and suppression, for which alphas ranged in the 0.60 s for Part 1 and Part 2 data surveys and for the combined data set.

The Depression, Anxiety, and Stress Scale (DASS; Lovibond and Lovibond, 1995) was used to measure depression, anxiety, and stress in the Part 2 survey. The DASS consists of 42 items, each of which is rated on a four-point scale: 0 = did not apply to me at all, 1 = applied to me to some degree, or some of the time, 2 = applied to me to a considerable degree, or a good part of time, and 3 = applied to me very much, or most of the time. Each of the three scales (Depression, Anxiety, and

Stress) consists of 14 items. Scores on each of the three scales range from 0 to 42. Participants were asked to rate how much each of the items applied to them over the past week at work. Examples of items are: "I couldn't seem to experience any positive feeling at all" (Depression), "I experienced trembling (e.g., in the hands)" (Anxiety), and "I found myself getting upset rather easily" (Stress). Lovibond and Lovibond (1995) report alpha coefficients for the three scales ranging from 0.81 to 0.91. Refer to Lovibond and Lovibond (1995) for validity data. In the current study, alphas of the three scales ranged from 0.94 to 0.96.

Desire for a permanent (tenure-track) position was measured with the following item: "Do you accept temporary work due to difficulty finding a permanent position?" This item was rated on a scale from 1 (no, not at all) to 5 (yes, to a large degree). This item was created as part of a five-item survey assessing reasons why faculty choose temporary work and was not originally written to specifically assess whether temporary faculty desire permanent positions; this explains why the item appears to be an indirect assessment of desire for a permanent position. As we began data analysis we determined that this item could be used to assess desire for a permanent position. The other four items of the survey were not utilized in the current study.

CODING OF QUALITATIVE DATA

In the Part 1 survey, participants were asked to answer the following open-ended question: Which aspects of your job do you find most stressful? If possible, list and describe at least two aspects. To capture the content of these responses, one author and a graduate student created a coding taxonomy to classify participant responses into various categories. The coding taxonomy was created based on an initial reading of approximately 20% of the participant responses. The final coding taxonomy comprises 13 distinct categories: contingency/precariousness; lack of respect; not allowed to participate in service/governance and/or department politics; grading; workload; lack of secretarial/colleague/university support (including physical work space); lack of recognition/invisibility; low pay/pay inequity; no benefits (health, etc.); difficult/demanding students; students academically unprepared/disengaged; pressure to write, publish, or conduct research; and pressure to produce high students outcomes/perform at high standards. An "uncodeable/junk" category allowed us to document content of the responses that was not relevant to teaching or university work. An "other" category allowed us to document any additional content related to teaching and university work that was not included in the coding taxonomy categories.

A graduate student coder, blind to study hypotheses, divided each of the participant responses into phrases, clauses, and sentences that expressed a distinct thought or idea; these constituted the text units for coding. Next, she coded each text unit for the presence of the themes captured by our coding taxonomy. The specific instructions given to the graduate student coder were: "Look at the full sentence. If everything in the sentence is junk, code as junk. If parts are not junk, code each distinct idea separately, and do *not* code the rest of the sentence as junk. Any single idea can receive more than one code." For example, the following response "Total lack of job security, living wage, health benefits, or access to opportunity for real professional development (i.e., being considered for full-time teaching opportunities—I've applied several times and not even been able to get an interview)" was coded as continency/precariousness, low pay/pay inequity, no benefits (health, etc.) and "other" for the reference to professional development, since only a small number of respondents mentioned lack of access to professional development.

Measures created from these codes reflect the proportion of the participants who mentioned a given theme in their response.

DATA ANALYSIS

Quantitative data analysis involved the following: We explored relationships between all study variables through Pearson correlations. Also, we conducted five standard multiple regressions, predicting the following variables: perceived harm, perceived stressors, depression, anxiety, and stress. Additionally, we conducted six multiple regressions to examine whether organizational commitment interacts with (a) perceived workplace harm and (b) perceived workplace stress in the prediction of depression, anxiety, and stress.

RESULTS

All quantitative data were analyzed using SPSS version 21. To correct for potential type I error due to the large number of analyses, alpha levels were set at 0.01.

DESCRIPTIVE STATISTICS

Means and standard deviations for organizational commitment, organizational identification, perceived stressors, perceived harm, and COPE scale variables for the Part 1 data set are presented in **Table 3**. Means and standard deviations for commitment, identification, stressors, harm, and COPE scale variables for the combined Part 1 and Part 2 data sets and DASS variables for the Part 2 data set are presented in **Table 4**.

PEARSON CORRELATIONS AND TEST–RETEST RELIABILITIES

The correlation matrix for age, sex, family income, participants' desire for a tenure-track position, commitment, identification, perceived stressors, perceived harm, and COPE variables for the Part 1 data set is presented in **Table 5**. We are reporting correlations between variables from the Part 1 data set rather than from the combined data set because demographic variables were measured only in the Part 1 data set. Additionally, the sample size for the Part 1 data set is significantly larger than the sample size for the combined data set ($n = 199$ vs. $n = 90$). The majority of variables that were measured in both the Part 1 and Part 2 surveys showed moderately high to high test–retest reliabilities in the combined data set. The variables which appeared in both surveys were commitment, identification, perceived stressors, perceived harm, and the COPE scales. Commitment and identification had test–retest reliabilities in the 0.80 s. The test–retest reliabilities for all COPE variables, with the exception of four were in the 0.60 and 0.70 s. The four exceptions were acceptance and suppression (0.50 s), religious coping (0.96), and denial (0.08). The test–retest reliability for perceived harm was 0.66 and for perceived stressors was 0.48. The low test–retest reliability

Table 3 | Means and standard deviations for commitment, identification, perceived stressors and harm, and COPE variables for the Part 1 survey.

Variable	Mean	Standard Deviation	Range
Commitment	31.63	10.03	10–53
Identification	22.89	7.70	6–41
Perceived stressors	2.42	1.23	0.6–5
Perceived harm	5.34	2.96	0–12
Growth	11.12	2.73	4–16
Mental disengagement	8.78	2.68	4–16
Venting	9.60	3.03	4–16
Instrumental support	10.96	3.06	4–16
Active coping	11.95	2.86	4–16
Denial	4.78	1.46	4–11
Religious coping	6.49	3.81	4–16
Humor	9.38	3.43	4–16
Behavioral disengagement	6.18	2.32	4–15
Restraint	10.07	2.72	4–16
Emotional support	11.12	3.47	4–16
Substance use	5.42	2.73	4–16
Acceptance	10.73	2.78	4–16
Suppression	9.35	2.47	4–16
Planning	12.83	2.77	4–16

Table 4 | Means and standard deviations for commitment, identification, perceived stressors and harm, COPE and DASS variables for the Part 2 survey.

Variable	Mean	Standard Deviation	Range
Commitment	31.01	9.68	13–53
Identification	22.22	7.58	9–41
Perceived stressors	2.31	1.21	0.6–5
Perceived harm	5.24	3.13	0–12
Growth	10.90	2.68	6–16
Mental disengagement	8.43	2.68	4–16
Venting	9.70	3.05	4–16
Instrumental support	10.86	3.02	4–16
Active coping	11.92	2.67	5–16
Denial	4.70	1.43	4–11
Religious coping	6.13	3.59	4–16
Humor	9.43	3.42	4–16
Behavioral disengagement	6.00	2.25	4–15
Restraint	9.79	2.85	4–16
Emotional support	11.24	3.34	4–16
Substance use	5.17	2.37	4–16
Acceptance	10.76	2.70	4–16
Suppression	9.47	2.46	4–16
Planning	12.70	2.67	6–16
Depression	7.52	9.75	0–41
Anxiety	4.15	7.10	0–38
Stress	10.06	9.97	0–38

for denial may be largely explained by the low variability for that variable ($SD = 1.43$), by far the lowest variability among the COPE variables.

The correlations between DASS variables measured in the Part 2 survey and age, sex, family income, participants' desire for a tenure-track position, commitment, identification, perceived stressors, perceived harm, and COPE variables measured in the combined data set are presented in **Table 6**.

PERCEPTIONS OF STRESSORS AND HARM AMONG CONTINGENT FACULTY

To examine the nature of stressors among contingent faculty in our sample, we looked first to the open-ended questions (qualitative data) in the Part 1 Survey, which asked participants to describe the most stressful aspects of their job. The responses mentioned by 10% or more of the sample were workload (31.9% of the sample), contingency/precariousness of status (31.4%), lack of support (including physical space; 30.4%), low pay or pay inequity (26.5%), not being allowed to participate in service/governance/department politics (18.6%), lack of recognition/invisibility (15.7%), and no benefits (health, etc.; 11.3%).

Next, we examined predictors of perceptions of harm and perceptions of workplace stressors. Perceptions of harm in the work environment correlated significantly and positively with age ($r = 0.23$, $p < 0.01$), desire for a tenure-track position ($r = 0.34$, $p < 0.001$), commitment ($r = 0.35$, $p < 0.001$), perceived stressors ($r = 0.52$, $p < 0.001$), venting ($r = 0.21$, $p < 0.01$), denial ($r = 0.21$, $p < 0.01$), and behavioral disengagement ($r = 0.26$, $p < 0.001$). Perceptions of workplace stressors correlated significantly and positively with sex ($r = 0.23$, $p < 0.001$; women reported higher workplace stressors), desire for a tenure-track position ($r = 0.38$, $p < 0.001$), identification ($r = 0.21$, $p < 0.01$), commitment ($r = 0.37$, $p < 0.001$), harm ($r = 0.52$, $p < 0.001$), denial ($r = 0.19$, $p < 0.01$), religious coping ($r = 0.22$, $p < 0.01$), and behavioral disengagement ($r = 0.19$, $p < 0.01$). The results indicate that desire for a tenure track position, both identification and commitment, and several disengagement coping mechanisms are correlated with perceptions of both harm and stressors in the workplace.

Next, we conducted two multiple regression analyses to determine which variables best predict perceived stressors and perceived harm. Each regression equation included the following variables as predictors: all demographic variables, identification, commitment, either perceived harm or perceived stressors (the variable which was not the dependent variable for the particular equation), and coping mechanisms for which the Pearson correlations with the dependent variable were significant. In the regression model predicting perceived workplace harm, age ($\beta = 0.228$, $p = 0.002$) and perceived stressors ($\beta = 0.337$, $p < 0.001$) were significant [$F_{(10,\ 146)} = 7.56$, $p < 0.001$; $R^2 = 0.36$, adjusted $R^2 = 0.31$]. In the regression model predicting perceived workplace stressors, sex ($\beta = 0.191$, $p = 0.006$, with women reporting higher workplace stressors than men), desire for a tenure-track position ($\beta = 0.223$, $p = 0.003$), perceived harm ($\beta = 0.261$, $p = 0.001$) and religious coping ($\beta = 0.246$, $p = 0.001$) were significant [$F_{(10,\ 146)} = 8.79$, $p < 0.001$; $R^2 = 0.39$,

Table 5 | Pearson correlations between demographic variables, commitment, identification, perceived harm, perceived stressors, and COPE variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1. Age	1.0																					
2. Sex	−0.3	1.0																				
3. Income	0.27***	−0.08	1.0																			
4. Perm position	−0.02	0.02	−0.18	1.0																		
5. Identification	0.01	0.09	−0.15	0.21**	1.0																	
6. Commitment	0.07	0.04	−0.09	0.33***	0.65***	1.0																
7. Harm	0.23***	0.10	−0.09	0.34***	0.17*	0.35***	1.0															
8. Stressors	0.00	0.23***	−0.16	0.38***	0.21**	0.37***	0.52***	1.0														
9. Growth	−0.04	0.15	−0.14	−0.03	−0.15	−0.19**	0.04	0.02	1.0													
10. Ment disengage	−0.22**	0.10	−0.26***	0.17	0.11	0.20**	0.16	0.16	0.08	1.0												
11. Venting	−0.01	0.14	−0.14	0.21**	0.10	0.14	0.21**	0.06	0.16	0.39***	1.0											
12. Instru support	−0.05	0.17	−0.17	0.06	−0.15	−0.12	0.14	0.00	0.48***	0.16	0.47***	1.0										
13. Active coping	0.07	0.12	−0.03	0.12	−0.15	−0.18*	0.13	0.04	0.52***	−0.06	0.29***	0.58***	1.0									
14. Denial	0.03	0.08	0.02	0.00	0.01	0.11	0.21**	0.19**	0.00	0.28***	0.27***	0.05	0.02	1.0								
15. Relig coping	−0.04	0.06	0.04	0.01	−0.12	−0.05	0.13	0.22**	0.23**	0.09	0.21**	0.13	0.15*	0.15*	1.0							
16. Humor	−0.04	−0.07	−0.13	0.10	0.08	0.02	0.15	0.08	0.20**	0.26***	0.11	0.18	0.13	0.11	−0.08	1.0						
17. Beh disengage	0.02	0.03	−0.11	0.16	0.29***	0.38***	0.26***	0.19**	−0.33***	0.39***	0.12	−0.13	−0.36***	0.34***	−0.13	0.03	1.0					
18. Restraint coping	0.15	0.12	−0.12	0.09	0.11	0.09	0.14	0.12	0.24***	0.13	0.02	0.18	0.14	0.14	0.19**	0.20**	0.28***	1.0				
19. Emot support	−0.04	0.30***	−0.07	0.04	0.02	−0.05	0.13	−0.05	0.38***	0.21**	0.62***	0.70***	0.35***	0.06	0.12	0.17	−0.12	0.08	1.0			
20. Substance use	−0.26***	−0.04	−0.12	−0.01	−0.04	−0.09	0.06	−0.04	0.01	0.38***	0.15	0.15	−0.06	0.17	−0.14	0.16	0.20**	−0.09	0.14	1.0		
21. Acceptance	−0.13	0.04	−0.18**	0.09	0.04	0.02	0.00	0.06	0.28***	0.16	−0.02	0.15	0.13	−0.05	−0.02	0.30***	0.03	0.34***	0.11	0.03	1.0	
22. Suppression	0.17	0.15	0.02	0.10	−0.14	−0.06	0.17	0.17	0.38***	0.11	0.39***	0.44***	0.61***	0.16	0.18	0.07	−0.08	0.24***	0.30***	−0.02	0.06	1.0
23. Planning	0.11	0.22**	−0.01	0.09	0.14	−0.18	0.15	0.11	0.54***	−0.04	0.17	0.50***	0.78***	0.01	0.13	0.11	−0.30***	0.24***	0.34***	−0.02	0.12	0.55***

Perm Position = desire for a permanent position, Ment Disengage = mental disengagement, Instru Support = instrumental support, Relig Coping = religious coping, Beh Disengage = behavioral disengagement, Emot support = emotional support. Coding of sex: 1 = male and 2 = female.

***p <.01, ***p < 0.001.*

Table 6 | Correlations of DASS variables with demographic variables, commitment, identification, stressors, harm, and COPE variables.

Variable	Depression	Anxiety	Stress
Age	−0.18	−0.11	−0.18
Sex	−0.09	−0.08	−0.17
Income	−0.38***	−0.29**	−0.30**
Permanent position	0.34**	0.28	0.39***
Commitment	0.32**	0.32**	0.32**
Identification	0.21	0.35***	0.20
Perceived harm	0.38***	0.39***	0.39***
Perceived stressors	0.34***	0.28**	0.30**
Growth	−0.16	0.03	−0.02
Mental disengagement	0.32**	0.20	0.26
Venting	0.28**	0.22	0.39***
Instrumental support	0.01	0.12	0.10
Active coping	−0.12	−0.03	0.02
Denial	0.11	0.15	0.21
Religious coping	−0.12	−0.02	0.07
Humor	0.07	0.27	0.18
Behavioral disengagement	0.41***	0.23	0.32**
Restraint coping	0.03	0.16	0.03
Emotional support	−0.01	0.13	0.09
Substance use	0.39***	0.44***	0.31**
Acceptance	0.00	−0.14	−0.04
Suppression	0.15	0.11	0.20
Planning	−0.23	−0.11	−0.17

Permanent Position = Desire for a permanent position. Coding of sex: 1 = male and 2 = female.

***p < 0.01, two-tailed, ***p < 0.001, two tailed.*

Table 7 | Standard multiple regression analysis predicting perceived harm in the workplace.

Variable	β	Unstd B	Std Error	95% CI
Age	0.23**	0.05	0.02	[0.02, 0.08]
Sex	0.04	0.24	0.45	[−0.66, 1.13]
Income	−0.06	−0.05	0.06	[−0.18, 0.07]
Desire perm position	0.13	0.26	0.15	[−0.04, 0.56]
Identification	−0.14	−0.05	0.03	[−0.12, 0.02]
Commitment	0.15	0.05	0.04	[−0.01, 0.10]
Perceived stressors	0.34**	0.79	0.20	[0.40, 1.18]
Behavioral disengagement	0.10	0.12	0.10	[−0.08, 0.31]
Denial	0.10	0.20	0.16	[−0.12, 0.51]
Venting	0.10	0.10	0.07	[−0.05, 0.24]

Coding of sex: 1 = male and 2 = female.

***p < 0.01 two-tailed.*

adjusted $R^2 = 0.35$]. Refer to **Tables 7**, **8** for summaries of these regression results.

COPING STRATEGIES AMONG CONTINGENT FACULTY

Mean scores on each of the COPE variables, as presented in **Table 3**, are compared to mean scores as reported by Carver et al. (1989) in their sample of college students. Results of one sample *t*-tests reveal some statistically significant differences between the current sample and Carver et al.'s sample. Carver et al.'s sample report somewhat higher rates of religious coping ($t = -8.47$, $p < 0.001$, mean difference of 2.23), growth coping ($t = -6.45$, $p < 0.001$, difference of 1.28), denial ($t = -12.29$, $p < 0.001$, difference of 1.29), acceptance ($t = -5.42$, $p < 0.001$, difference of 1.11), mental disengagement ($t = -4.54$, $p < 0.001$, difference of 0.87), and suppression ($t = -3.14$, $p < 0.01$, difference of 0.57) than the current sample. Mean scores for humor and substance use are not available in Carver et al.'s sample. In summary, Carver et al.'s college student sample reported higher use of two engagement (growth, acceptance) and two disengagement mechanisms (denial, mental disengagement) than contingent faculty; there is no evidence that the two groups differ significantly in the ratio of use of engagement or disengagement mechanisms. The most notable difference between the two groups is that contingent faculty members in the current sample report a low rate of religious coping compared to the college student sample.

In the current sample, sex correlated with two coping mechanisms. Specifically, women reported significantly more use of seeking emotional support ($r = 0.30$, $p < 0.001$) and of planning ($r = 0.22$, $p < 0.01$) than did men. The result regarding support seeking is consistent with past research (Tamres et al., 2002). Age correlated with coping mechanisms such that older people utilized less mental disengagement ($r = -0.22$, $p < 0.01$) and substance use ($r = -0.26$, $p < 0.001$) than did younger people, indicating a tendency for older people to utilize less maladaptive coping mechanisms than younger people. These findings are generally consistent with past research (Aldwin, 2011).

Table 8 | standard multiple regression predicting perceived stressors in the workplace.

Variable	β	Unstd B	Std Error	95% CI
Age	−0.07	−0.01	0.01	[−0.02, 0.01]
Sex	0.19**	0.50	0.18	[0.14, 0.85]
Income	−0.02	−0.01	0.03	[−0.06, 0.05]
Desire perm position	0.22**	0.19	0.06	[0.06, 0.31]
Identification	−0.06	−0.01	0.02	[−0.04, 0.02]
Commitment	0.17	0.02	0.01	[−0.00, 0.05]
Perceived harm	0.26***	0.11	0.03	[0.04, 0.18]
Behavioral disengagement	0.06	0.03	0.04	[−0.05, 0.11]
Denial	−0.00	−0.00	0.06	[−0.13, 0.12]
Religious coping	0.25***	0.08	0.02	[0.03, 0.13]

Coding of sex: 1 = male and 2 = female.

***p < 0.01 two-tailed, ***p < 0.001 two-tailed.*

CONTINGENT FACULTY EXPERIENCES OF DEPRESSION, ANXIETY, AND STRESS

Scores on the DASS variables in the current sample all fall within "normal" ranges for each of the three variables, as reported by Lovibond and Lovibond (1995).

Results in **Table 6** revealed that depression correlated significantly and positively with the desire for a tenure-track position ($r = 0.34$, $p < 0.01$), commitment ($r = 0.32$, $p < 0.01$),

perceived stressors ($r = 0.34$, $p < 0.001$), perceived harm ($r = 0.38$, $p < 0.001$), mental disengagement ($r = 0.32$, $p < 0.01$), venting ($r = 0.28$, $p < 0.01$), behavioral disengagement ($r = 0.41$, $p < 0.001$), substance use ($r = 0.39$, $p < 0.001$), and negatively with income ($r = -0.38$, $p = 0.001$). Anxiety correlated significantly and positively with commitment ($r = 0.32$, $p < 0.01$), identification ($r = 0.35$, $p < 0.001$), perceived stressors ($r = 0.28$, $p < 0.01$), perceived harm ($r = 0.39$, $p < 0.001$), and substance use ($r = 0.44$, $p < 0.001$) and negatively with income ($r = -0.29$, $p < 0.01$). Stress correlated significantly and positively with desire for a tenure-track position ($r = 0.39$ $p < 0.001$), commitment ($r = 0.32$, $p < 0.01$), perceived stressors ($r = 0.30, p < 0.01$), perceived harm ($r = 0.39, p < 0.001$), venting ($r = 0.39$, $p < 0.001$), behavioral disengagement ($r = 0.32$, $p < 0.01$), and substance use ($r = 0.31, p < 0.01$) and negatively with income ($r = -0.30$, $p < 0.01$). Desire for a tenure-track position, commitment, perceived harm, perceived stressors, and several disengagement coping mechanisms correlated positively with each of the three predicted variables (depression, anxiety, and stress), and income correlated negatively with all three variables. All predictor variables were measured at time 1 and the predicted variables (depression, anxiety, stress) were measured at time 2, 2–4 months later.

Regressions were conducted to determine which variables best predict depression, anxiety, and stress. Each regression equation included the following variables as predictors: all demographic variables, identification, commitment, harm, stress, and coping mechanisms for which Pearson correlations with the predicted variable were significant. In the regression model predicting depression, substance use was significant [$\beta = 0.446$, $p < 0.001$; $F_{(12, 62)} = 4.29$, $p < 0.001$; $R^2 = 0.51$, adjusted $R^2 = 0.39$]. In the regression model predicting anxiety, sex ($\beta = 0.300$, $p = 0.006$) and substance use ($\beta = 0.367$, $p = 0.002$) were significant [$F_{(9, 67)} = 5.15$, $p < 0.001$; $R^2 = 0.44$, adjusted $R^2 = 0.36$], with men reporting higher anxiety than women. When predicting stress, sex ($\beta = -0.408$, $p = 0.001$), age ($\beta = -0.297$, $p = 0.01$), and venting ($\beta = 0.293$, $p = 0.008$) were significant [$F_{(11, 63)} = 4.65$, $R^2 = 0.50$, adjusted $R^2 = 0.39$], with men reporting higher stress than women. Age was a negative predictor. Refer to **Tables 9–11** for complete regression results. Pearson correlations between sex and anxiety, sex and stress, and age and stress were not significant while sex and/or age emerged as significant predictors in the regressions involving these variables. These discrepancies are due to missing data in the regressions; Pearson correlations involved sample sizes of about 90 whereas regressions involved sample sizes of about 65.

Table 9 | Standard multiple regression predicting depression.

Variable	β	Unstd B	Std Error	95% CI
Age	−0.12	−0.08	07	[−0.23, 0.07]
Sex	−0.28	−5.43	2.19	[−9.83, −1.04]
Income	−0.07	−0.18	0.32	[−0.82, 0.45]
Desire perm position	0.13	0.80	0.76	[−0.72, 2.31]
Identification	0.09	0.11	0.17	[−0.22, 0.44]
Commitment	0.23	0.25	0.19	[−0.13, 0.64]
Perceived harm	−0.02	−0.07	0.49	[−1.04, 0.90]
Perceived stress	0.02	0.14	1.10	[−2.08, 2.36]
Behavioral disengagement	0.18	0.76	0.51	[−0.27, 1.78]
Mental disengagement	−0.02	−0.08	0.47	[−1.02, 0.86]
Venting	0.06	0.20	0.36	[−0.52, 0.93]
Substance use	0.45***	1.79	0.47	[0.85, 2.73]

Coding of sex: 1 = male and 2 = female.
****p < 0.001 two-tailed.*

Table 10 | Standard multiple regression predicting anxiety.

Variable	β	Unstd B	Std Error	95% CI
Age	−0.13	−0.07	0.06	[−0.18, 0.04]
Sex	−0.30**	−4.53	1.60	[−7.74, −1.32]
Income	0.01	0.03	0.23	[−0.44, 0.49]
Desire perm position	0.05	0.23	0.55	[−0.88, 1.33]
Identification	0.28	0.27	0.12	[0.03, 0.51]
Commitment	0.16	0.13	0.12	[−0.11, 0.37]
Perceived harm	0.16	0.38	0.37	[−0.36, 1.12]
Perceived stress	0.06	0.36	0.82	[−1.28, 2.00]
Substance use	0.37**	1.18	0.36	[0.46, 1.90]

Coding of sex: 1 = male and 2 = female.
***p < 0.01 two-tailed.*

ORGANIZATIONAL COMMITMENT AMONG CONTINGENT FACULTY

The mean score for organizational commitment in the current study is comparable to results reported by Fuller et al. (2006), who studied organizational commitment in university employees (31 administrators, 131 staff, and 157 faculty) at a medium sized university in the United States utilizing Allen and Meyer's (1990) measure. Commitment in the current study (mean = 31.63) was higher than that reported by Fuller et al. (mean = 28.63, $t = 4.17$, $p < 0.001$). In our sample, organizational commitment did not correlate with age or sex, contrary to previous research which has shown higher levels of organizational commitment among older employees and women in non-academic employees (Mathieu and Zajac, 1990; McFarlin and Sweeney, 1992; Kacmar et al., 1999).

Six regressions were conducted to examine whether organizational commitment interacted with (a) perceived workplace harm and (b) perceived workplace stress in the prediction of depression, anxiety, and stress. None of the six regressions produced a significant interaction effect. Therefore, the six regressions failed to support the notion that organizational commitment buffered the effect of either perceived harm or perceived stress in the workplace on depression, anxiety, or stress.

DISCUSSION

Research on the impact of contingent faculty in higher education has tended to focus on the impact of contingency on universities and on students, with less attention paid to the experiences and psychological well-being of contingent faculty themselves. In particular, previous research has not identified common workplace stressors for contingent faculty nor has it addressed the impact of contingency on longer-term health outcomes such as depression and anxiety in the context of academic work. To address

Table 11 | Standard multiple regression predicting stress.

Variable	β	Unstd B	Std Error	95% CI
Age	−0.30**	−0.21	0.78	[−0.37, −0.05]
Sex	−0.41***	−8.36	2.29	[−12.95, −3.77]
Income	0.01	0.04	0.32	[−0.61, 0.68]
Desire perm position	0.08	0.50	0.79	[−1.08, 2.07]
Identification	0.16	0.21	0.17	[−0.13, 0.55]
Commitment	0.02	0.02	0.19	[−0.36, 0.40]
Perceived harm	0.30	0.96	0.51	[−0.06, 1.97]
Perceived stress	0.08	0.61	1.16	[−1.72, 2.94]
Behavioral disengagement	−0.00	−0.01	0.52	[−1.05, 1.04]
Venting	0.29**	0.98	0.36	[0.26, 1.70]
Substance use	0.14	0.58	0.36	[−0.41, 1.56]

Coding of sex: 1 = male and 2 = female.
$^{**}p < 0.01$ two-tailed, $^{***}p < 0.001$ two-tailed.

the latter, this study investigated predictors of perceptions of workplace stressors and harm and depression, anxiety, and stress among faculty who work off the tenure track. Specifically, we examined the role that demographic factors, situational variables (e.g., total family income), organizational commitment and identification, and individual coping mechanisms may play in shaping the psychological experiences of contingent faculty.

COMMON WORKPLACE STRESSORS AND SITUATIONAL FACTORS AFFECTING STRESS, ANXIETY, AND DEPRESSION

A primary purpose of this study was to examine workplace stressors among NTT faculty. Research conducted in non-academic workplace settings finds that temporary work status is associated with stress, such that temporary workers report more stress than permanent employees (Benavides et al., 2000). We were not able to compare stressors or stress levels of NTT and tenure-track faculty in our study, but did identify common workplace stressors in our NTT sample. In response to an open-ended question about the most stressful aspects of their work, from which we obtained qualitative data, a substantial proportion of faculty in our sample listed contingency or the precariousness of their position as one of the most significant stressors that they experience. This finding is consistent with previous studies of workplace stress, which argue that temporary employment itself is a source of stress. NTT faculty in our sample also identified heavy workload, lack of institutional support such as access to a physical office, and low pay or pay inequity as significant sources of stress.

Much of our quantitative data corroborated the above results from our open-ended survey question. Two situational factors—lower family income and inability to find permanent work—emerged as risk factors across several different areas of our results. NTT faculty who would prefer a permanent position were more likely to perceive stressors in the workplace, and NTT faculty who would prefer a permanent position and those with lower family incomes were more likely to experience depression, anxiety, and stress. Together, these findings suggest that faculty who are financially insecure, and the estimated 50% of NTT faculty who desire full-time work may be particularly at risk for negative health outcomes. A desire for a permanent job may be an additional indicator of low or insufficient income—indeed, the two were correlated in our sample ($r = -0.18$, $p < 0.05$). Alternatively, a desire for a permanent job may represent an interest in the additional job security, resources, representation, status and recognition that a permanent position would bring. In the absence of permanent positions for all NTT faculty—some NTT positions will always exist since not all faculty desire permanent positions—providing as many of these benefits as possible may help to mitigate negative effects.

ORGANIZATIONAL COMMITMENT AND IDENTIFICATION

We also examined how NTT faculty's psychological attachment to their university, in the form of organizational identification and commitment, may impact their stress-related perceptions and experiences. We found that organizational commitment and organizational identification are associated with a tendency to see greater harm and to experience more stressors in the workplace. In particular, we found that organizational identification was weakly associated with perceptions of stressors and harm, whereas organizational commitment was moderately correlated with perceptions of stressors and harm. Identification represents a "first level" of commitment to a university that may or may not develop into a deeper dedication, in the form of organizational commitment. These findings suggest that the more connected NTT faculty are to an institution, the more likely they are to perceive stressors and harm. A psychological attachment to a university may make NTT faculty more attentive and sensitive to potentially harmful events occurring on campus.

Our results also indicated that organizational identification and commitment are associated with the extent to which faculty experience depression, anxiety, and stress. Faculty who were higher in organizational identification and commitment tended to report higher levels of anxiety. Additionally, faculty who were higher in organizational commitment (but not identification) tended to report higher levels of depression and stress. These findings suggest that a psychological attachment to an organizational may be a risk factor for temporary employees. The results of this study also suggest that, rather than acting as a buffer against stress as in previous research with other groups of employees (e.g., Meyer and Allen, 1997), organizational commitment may predispose NTT faculty to stress. Indeed, some recent research indicates that organizational commitment may be detrimental to temporary employees because it heightens the damage to well-being that occurs when temporary employees' work situations are modified outside their control (Galais and Moser, 2009). Our findings with regard to depression, anxiety, and stress are consistent with this possibility.

COPING MECHANISMS

In general, NTT faculty in our sample used engagement and disengagement coping mechanisms at rates similar to those reported in a large undergraduate sample (Carver et al., 1989). Our correlational results support the notion that disengagement coping mechanisms such as denial, behavioral disengagement (giving up), and substance abuse, may predispose NTT faculty to perceiving harm and stressors in the workplace, and to depression, anxiety, and stress. In addition to calculating Pearson correlations

between variables, we conducted regressions in order to determine which variables (demographic, situational, identification, commitment, and coping mechanisms) predicted perceived stressors, perceived harm, depression, anxiety, and stress, when all other variables were held constant. We found that, in the regressions which predicted depression and anxiety, one disengagement coping mechanism (substance use) emerged as a predictor, showing that substance use independently contributed to depression and anxiety, above and beyond the contribution of other variables, such as family income or inability to find a permanent job. In the regression which predicted stress, the coping mechanism venting emerged as an independent predictor. Venting, which involves letting out one's feelings with others, although not entirely "bad," often appears to operate as more dysfunctional than functional, especially by comparison to more proactive coping mechanisms such as planning and active coping (Connor-Smith and Flachsbart, 2007). These results suggest that one intervention for NTT faculty could be teaching them to utilize functional coping mechanisms while discouraging the use of dysfunctional coping mechanisms.

DEMOGRAPHIC FACTORS

With the expectation that individuals will experience and cope with stressors and stress in different ways, we were also interested in examining sources of variation in NTT faculty's experiences of stressors and stress. Consistent with previous research on contingent faculty experiences, our results indicated that demographic factors—age and sex—are associated with NTT faculty experiences of stressors and harm and may predispose one to depression, anxiety, and stress. In particular, older faculty were more likely to perceive harm in the workplace, and also reported lower levels of stress than their younger counterparts. Older faculty in our sample also tended to use less maladaptive coping methods than younger faculty. These findings are consistent with previous research on coping, which finds that older adults may use more efficient coping mechanisms and are better at regulating negative emotions, resulting in lower stress levels (Aldwin, 2011). However, older NTT faculty were equally likely to perceive stressors in the workplace, and reported similar levels of anxiety and depression, compared to younger faculty.

Consistent with previous studies, we found that among contingent faculty, women reported more social support seeking, and were more likely to perceive stressors at work. However, in the current study, sex was not correlated with depression, anxiety, or stress when Pearson correlations were calculated. In regressions involving anxiety and stress, which utilized a subset of the sample upon which Pearson correlations were calculated (due to missing data), men reported higher anxiety and stress than women. The findings regarding depression and anxiety are inconsistent with previous research utilizing the DASS and with knowledge about gender differences in clinical diagnosis. Specifically, in a large non-clinical sample of adults in a previous study, women scored significantly higher than men on both the Depression and the Anxiety scales of the DASS (Crawford and Henry, 2003). Additionally, diagnoses of major depressive disorder and of most anxiety disorders in the United States are more common among women than among men (American Psychiatric Association, 2013). Our findings may suggest greater psychological similarity between women and men NTT faculty than among women and men in the general population, at least in regard to experiences of depression and anxiety. Further research could investigate whether these findings are reliable.

Women and men in the current sample did not differ in regard to stress as measured by the Stress scale of the DASS, which is a measure of stress reactions. These findings are consistent with the results of Crawford and Henry's (2003) study utilizing the DASS Stress scale. Earlier research on gender differences in stress reactions has produced complex results. In general, women are more reactive to stressors than are men, for a wide variety of stressors, but if the stressors are work-related or financial, results have been inconsistent, with a slight tendency for research to show that men experience more extreme stress reactions to work-related and financial stressors than do women (Helgeson, 2011). Our own results mirror this inconsistency in the literature; as mentioned above, in our regression analyses conducted on a subset of our sample due to missing data, the pattern of results was somewhat different than the Pearson correlation results. In the regression analysis, women reported lower levels of stress, relative to their male counterparts.

FUTURE DIRECTIONS AND LIMITATIONS

Our research results show that contingent faculty who have lower family incomes, who have been unable to find a permanent position, who are most committed to their institution, and who use dysfunctional coping mechanisms are most likely to perceive higher levels of workplace stressors and harm and to experience higher levels of depression, anxiety, and stress. What can be done to help these faculty to achieve higher levels of well-being? The interventions that are most likely to be successful are those that occur at the institutional level, given that the institution controls access to resources which satisfy human needs at the most basic survival levels (e.g., income for all basic needs, job security to satisfy safety and security needs) and at higher levels of need (e.g., participation in governance to partially satisfy need for respect from TT peers). In our results, the relationship between a worker's commitment to their institution and their psychological well-being is the obverse of this relationship in most other samples of employees; committed employees, in other samples, typically experience fewer negative emotional states than those who are less committed. An employer or institution which fails to reward committed employees, and which instead behaves in ways that could be perceived by the employees as punishment (e.g., through classifying an employee as "temporary" for many years or decades, through failing to recognize the employee's contribution, through placing a low ceiling on pay) is doing a disservice not only to the employees but also to the institution itself. In the case of universities, harm to the faculty is likely to indirectly cause harm to the students and therefore to the mission of the institution. The reward for committed employees could, and should, include recognition, support, compensation, and participation in shared governance, which are factors that have been found to be associated with greater organizational commitment in employees in other samples (Wayne et al., 1997; Kacmar et al., 1999; Murphy, 2009).

Although interventions at the level of the institution are important, faculty may also be able to act individually by modifying their responses to workplace stressors. Two dysfunctional coping mechanisms (substance use and venting) contributed to one or more of the negative emotion outcomes variables (depression, anxiety, stress) independently of all other variables included in the regressions. Those NTT faculty who utilize dysfunctional coping mechanisms at a relatively high rate could commit to learning more functional coping mechanisms such as planning, active coping, and seeking instrumental (tangible) social support from others. Universities could offer coping workshops for employees. However, we caution that such training may prove more difficult than it may sound. It is possible that, among the NTT faculty in our sample, contingent work conditions may have led to or enhanced the development of the dysfunctional coping mechanisms. Possibly, for many or most of the individuals who are already suffering from depression, anxiety, or stress, changing oneself would do little to improve their well-being; a change in their circumstances may be required. Our uncertainty regarding the meaning of this finding reflects the primary limitation of our study, which is that it is correlational in nature and we cannot determine the causal relationships between many of our variables. Related to this, although we showed through our longitudinal design that a variety of variables (e.g., perception of workplaces stressors and harm, coping mechanisms) predicted depression, anxiety, and stress 2–4 months later, results which are consistent with the interpretation that workplace stressors, harm, and coping mechanisms partially cause levels of depression, anxiety, and stress, a stronger methodology is still needed to rule out alternative explanations of these correlational findings.

Future research should investigate the reliability of our findings that the most committed contingent faculty are also the ones whose well-being most suffers. We could extend this research by investigating the nature and deeper meaning of organizational commitment that occurs among some contingent faculty. Given that these faculty typically receive low pay and have little job security, and many have spent years in graduate school earning PhDs or other higher degrees, what types of sacrifices have they made in non-work areas of their lives? Do they have children, life partners, deep friendships? If their lives have involved sacrifice in these areas, what types of feelings do they have about having made these sacrifices? Is the amount of sacrifice in one's life outside of work associated with greater commitment to one's institution?

The study of psychological well-being among contingent faculty is uncharted territory. We have investigated relationships between several psychological variables, seeking to predict depression, anxiety, and stress in a group of contingent faculty. Hundreds of thousands of individuals in the United States work as contingent faculty, with millions of contingent faculty workers in the world (Curtis, 2014). Further research on factors which affect the well-being of this group of employees may lead to improvement in the lives of millions of contingent workers and their families.

CONCLUSION

The present study examined experiences of stress and coping among NTT faculty. Due to a variety of trends in higher education, NTT faculty are a growing population whose contingent academic appointments are likely to produce unique stressors and possibly negative health effects. We found that NTT faculty perceive stressors at work that are related to their contingent positions. Demographic and situational factors, dysfunctional coping mechanisms, and organizational commitment and identification were associated with more negative psychological experiences. Our findings suggest possibilities for institutional intervention. Overall, we argue that universities would be well-served by attending to the needs of NTT faculty on campus in order to mitigate negative outcomes for institutions, students, and faculty. In tandem with improving the working conditions of NTT faculty, we support investigating the position that the AAUP (2014) takes—that the dramatic increase in NTT positions and decrease in tenure line positions that has occurred in recent decades may not be economically necessary.

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REFERENCES

Aldwin, C. (2011). "Stress and coping across the lifespan," in *The Oxford Handbook of Stress, Health, and Coping*, ed S. Folkman (New York, NY: Oxford University Press), 15–34.

Allen, N. J., and Meyer, J. P. (1990). The measurement and antecedents of affective, continuance, and normative commitment to the organization. *J. Occup. Psychol.* 63, 1–18. doi: 10.1111/j.2044-8325.1990.tb00506.x

Allman, E., Berry, D., and Nasir, L. (2009). Depression and coping in heart failure patients: a review of the literature. *J. Cardiovasc. Nurs.* 24, 106–117. doi: 10.1097/JCN.0b013e318197a985

American Association of University Professors (AAUP). (2013). *The Inclusion in Governance of Faculty Holding Contingent Appointments*. Available online at: http://www.aaup.org/report/governance-inclusion

American Association of University Professors (AAUP). (2014). *Background Facts on Contingent Faculty*. Available online at: http://www.aaup.org/issues/contingency/background-facts (Retrieved March 14, 2014).

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders, 5th Edn*. Washington, DC: American Psychiatric Association.

Ashforth, B. E., and Mael, F. A. (1989). Social identity theory and the organization. *Acad. Manag. Rev.* 14, 20–39. doi: 10.5465/AMR.1989.4278999

Baldwin, R., and Chronister, J. (2001). *Teaching Without Tenure: Practices and Policies for a New Era*. Baltimore, MD: Johns Hopkins University Press.

Baldwin, R. G., and Wawrzynski, M. R. (2011). Contingent faculty as teachers: what we know; what we need to know. *Am. Behav. Sci.* 55, 1485–1509. doi: 10.1177/0002764211409194

Barker, K., and Christensen, K. (1998). "Controversy and challenges raised by contingent work environments," in *Contingent Work: American Employment*

Relations in Transition, eds K. Barker and K. Christensen (Ithaca, NY: Cornell University Press), 1–18.

Barnes, L. B., Agago, M. O., and Combs, W. T. (1998). Effects of job-related stress on faculty intention to leave academia. *Res. High. Educ.* 39, 457–464. doi: 10.1023/A:1018741404199

Benavides, F., Benach, J., Diez-Roux, A., and Roman, C. (2000). How do types of employment relate to health indicators? Findings from the second European survey on working conditions. *J. Epidemiol. Community Health* 54, 494–501. doi: 10.1136/jech.54.7.494

Benavides, F. G., and Benach, J. (1999). *Precarious Employment and Health-Related Outcomes in the European Union*. Luxembourg: Office for Official Publications of the European Communities.

Berret, B. (2008). Examining the participation of contingent faculty in the shared governance of institutions of higher education. *Doctoral Dissertation, Widener University. Dissertation Abstracts International Section A: Humanities and Social Sciences*, 38.

Bland, C. J., Center, B. A., Finstad, D. A., Risbey, K. R., and Staples, J. (2006). The impact of appointment type on the productivity and commitment of full-time faculty in research and doctoral institutions. *J. High. Educ.* 77, 89–124. doi: 10.1353/jhe.2006.0002

Blau, P. M. (1964). *Exchange and Power in Social Life*. New York, NY: J. Wiley & Sons.

Bok, D. C. (2006). *Our Underachieving Colleges: A Candid Look at how much Students Learn and why they Should be Learning More*. Princeton, NJ: Princeton University Press.

Bradburn, E. M., Sikora, A. C., and Zimbler, L. J. (2002). *The Gender and Racial/Ethnic Differences in Salary and Other Characteristics of Postsecondary Faculty.* Washington, DC: U.S. Department of Education.

Bradley, G. (2004). Contingent faculty and the new academic labor system. *Academe* 90, 28–31. doi: 10.2307/40252585

Carver, C. S., Scheier, M. F., and Weintraub, J. K. (1989). Assessing coping strategies: a theoretically based approach. *J. Pers. Soc. Psychol.* 56, 267–283. doi: 10.1037/0022-3514.56.2.267

Chait, R. (1997, February 7). Thawing the cold war over tenure: why academe needs more employment options. *Chron. High. Educ.* p. B4.

Coalition on the Academic Workforce (CAW). (2012). *A Portrait of Part-Time Faculty Members*. Coalition on the Academic Workforce, 1–51.

Compas, B. E., Connor-Smith, J. K., Saltzman, H., Thomsen, A. H., and Wadsworth, M. E. (2001). Coping with stress during childhood and adolescence: problems, progress, and potential in theory and research. *Psychol. Bull.* 127, 87–127. doi: 10.1037/0033-2909.127.1.87

Connelly, C. E., and Gallagher, D. G. (2004). Emerging trends in contingent work research. *J. Manage.* 30, 959–983. doi: 10.1016/j.jm.2004.06.008

Connor-Smith, J. K., and Flachsbart, C. (2007). Relations between personality and coping: a Meta-analysis. *J. Pers. Soc. Psychol.* 93, 1080–1107. doi: 10.1037/0022-3514.93.6.1080

Crawford, J. R., and Henry, J. D. (2003). The Depression Anxiety Stress Scales (DASS): normative data and latent structure in a large non-clinical sample. *Br. J. Clin. Psychol.* 42, 111–131. doi: 10.1348/014455603321903544

Curtis, J. (2014). *The Employment Status of Instructional Staff Members in Higher Education, Fall 2011*. Washington, DC: American Association of University Professors.

Curtis, J. W., and Jacobe, M. F. (2006). *AAUP Contingent Faculty Index*. Washington, DC: Association of American University Professors.

Curtis, J. W., and Thornton, S. (2013). *Here's the News: The Annual Report on the Economic Status of the Profession, 2013-2013*. Washington, DC: American Association of University Professors.

Davis, M. C., Matthews, K. A., and Twamley, E. W. (1999). Is life more difficult on mars or venus? A meta-analytic review of sex differences in major and minor life events. *Ann. Behav. Med.* 21, 83–97. doi: 10.1007/BF02895038

Dutton, D. (2009). An Exploration of the Motivation and Experience of Contingent Academic Faculty in a University Setting. *Doctoral Dissertation, University of Calgary. Dissertation Abstracts International Section A: Humanities and Social Sciences*, 71, 102.

Ehrenberg, R. G., and Zhang, L. (2005). Do tenured and tenure-track faculty matter? *J. Hum. Resour.* 40, 647–659. doi: 10.3368/jhr.XL.3.647

Fuller, B. J., Hester, K., Barnett, T., Frey, L., and Relyea, C. (2006). Perceived organizational support and perceived external prestige: predicting organizational attachment for university faculty, staff, and administrators. *J. Soc. Psychol.* 146, 327–347. doi: 10.3200/SOCP.146.3.327-347

Galais, N., and Moser, K. (2009). Organizational commitment and the well-being of temporary agency workers: a longitudinal study. *Hum. Relat.* 62, 589–620. doi: 10.1177/0018726708101991

Gandy, M., Sharpe, L., and Perry, K. (2012). Psychosocial predictors of depression and anxiety in patients with epilepsy: a systematic review. *J. Affect. Disord.* 140, 222–232. doi: 10.1016/j.jad.2011.11.035

Gappa, J. M., Austin, A. E., and Trice, A. G. (2007). *Rethinking Faculty Work: Higher Education's Strategic Imperative.* San Francisco, CA: Jossey-Bass.

Gappa, J. M., and Leslie, D. W. (1993). *The Invisible Faculty: Improving the Status of Part-Timers in Higher Education*. San Francisco, CA: Jossey-Bass.

Gappa, J. M., and Leslie, D. W. (2002). Part-Time Faculty: Competent and Committed. *New Dir. Commun. Coll.* 188, 59–67. doi: 10.100 2/cc.64

Groff, K. (2012). *Examining the Moderating Role of Organizational Commitment in the Relationship Between Shocks and Workplace Outcomes*. Graduate School Theses and Dissertations. Available online at: http://scholarcommons.usf.edu/etd/4058

Hagedorn, L. S. (2000). "Conceptualizing faculty job satisfaction: components, theories, and outcomes," in *What Contributes to Job Satisfaction Among Faculty and Staff*, ed L. S. Hagedorn (San Francisco, CA: Jossey-Bass), 5–20.

Helgeson, V. (2011). "Gender, stress, and coping," in *The Oxford Handbook of Stress, Health, and Coping*, ed S. Folkman (New York, NY: Oxford University Press), 63–85. doi: 10.1093/oxfordhb/9780195375343.013.0002

Jaeger, A. J., Thornton, C. H., and Eagan, K. (2007). "Effects of faculty type on first year student retention and performance," in *Paper Presented at the Meeting of the Association for the Study of Higher Education* (Louisville, KY).

Johnson, I. Y. (2011). Contingent instructors and student outcomes: an artifact or a fact? *Res. High. Educ.* 52, 761–785. doi: 10.1007/s11162-011-9219-2

Kacmar, K. M., Carlson, D. S., and Brymer, R. A. (1999). Antecedents and consequences of organizational commitment: a comparison of two scales. *Educ. Psychol. Meas.* 59, 976–996. doi: 10.1177/00131649921970297

Kallenberg, A. L. (2000). Nonstandard employment relations: part-time, temporary, and contract work. *Annu. Rev. Sociol.* 26, 341–365. doi: 10.1146/annurev.soc.26.1.341

Koys, D. J. (1988). Human resource management and a culture of respect: effects on employees organizational commitment. *Employ. Respons. Rights J.* 1, 57–70. doi: 10.1007/BF01385453

Kraimer, M. L., Wayne, S. J., Liden, R. C., and Sparrowe, R. T. (2005). The role of job security in understanding employees' perceptions of temporary workers and employees' performance. *J. Appl. Psychol.* 90, 389–398. doi: 10.1037/0021-9010.90.2.389

Lease, S. H. (1999). Occupational role stressors, coping, support, and hardiness as predictors of strain in academic faculty: an emphasis on new and female faculty. *Res. High. Educ.* 30, 285–304. doi: 10.1023/A:1018747000082

Lewis, V. (2012). Prediction of Job Satisfaction Based on Workplace Facets for Adjunct Business Faculty at Four-Year Universities. *Doctoral Dissertation, Oklahoma State University. Dissertation Abstracts International Section A: Humanities and Social Sciences*, 73(10-A), E.

Li, R., Cooper, C., and Livingston, G. (2014). Relationship of coping style to mood and anxiety disorders in dementia carers. *Curr. Opin. Psychiatry* 27, 52–56. doi: 10.1097/YCO.0000000000000020

Liden, R. C., Wayne, S. J., Kraimer, M. L., and Sparrowe, R. T. (2003). The dual commitments of contingent workers: an examination of contingents; commitment to the agency and the organization. *J. Organ. Behav.* 24, 609–625. doi: 10.1002/job.208

Lovibond, S. H., and Lovibond, P. F. (1995). *Manual for the Depression Anxiety and Stress Scales, 2nd Edn.* Sydney, NSW: Psychology Foundation.

Mael, F., and Ashforth, B. E. (1992). Alumni and their Alma Mater: a partial test of the reformulated model of organizational identification. *J. Organ. Behav.* 13, 103–123. doi: 10.1002/job.4030130202

Mathieu, J. E., and Zajac, D. M. (1990). A review and meta-analysis of the antecedents, correlates, and consequences of organizational commitment. *Psychol. Bull.* 108, 171–194. doi: 10.1037//0033-2909.108.2.171

McFarlin, D. B., and Sweeney, P. D. (1992). Distributive and procedural justice as predictors of satisfaction with personal and organizational outcomes. *Acad. Manage. J.* 35, 626–637. doi: 10.2307/256489

McGinnis, S. K., and Morrow, P. C. (1990). Job attitudes among full-time and part-time employees. *J. Vocat. Behav.* 36, 82–96. doi: 10.1016/0001-8791(90)90016-U

Meyer, J. P., and Allen, N. J. (1991). A three-component conceptualization of organizational commitment. *Hum. Resour. Manage. Rev.* 1, 61–89. doi: 10.1016/1053-4822(91)90011-Z

Meyer, J. P., and Allen, N. J. (1997). *Commitment in the Workplace: Theory, Research, and Application.* Thousand Oaks, CA: Sage.

Mowday, R. T., Porter, L. W., and Steers, R. M. (1982). *Employee-Organization Linkages: The Psychology of Commitment, Absenteeism, and Turnover.* New York, NY: Academic Press.

Mowday, R. T., Steers, R. M., and Porter, L. W. (1979). The measurement of organizational commitment. *J. Vocat. Behav.* 14, 224–247. doi: 10.1016/0001-8791(79)90072-1

Murphy, M. (2009). Contingent faculty: what impacts their organizational commitment? *Doctoral Dissertation, North Carolina State University. Dissertation Abstracts International Section A: Humanities and Social Sciences*, 70, 1583.

New Faculty Majority (NFM). (2012). *NFM National Unemployment Compensation Initiative.* Available online at: http://www.newfacultymajority.info/equity/projects-a-initiatives/projects/2012-06-20-22-45-48

Outcalt, C. L. (2002). "Community college faculty: characteristics, practices, and Challenges," in *New Direction for Community Colleges, No. 118*, 109–115. Available online at: http://files.eric.ed.gov.proxylib.csueastbay.edu/fulltext/ED467454.pdf

Palmer, J. C. (2002). "Disciplinary variations in the work of full-time faculty members," in *New Directions for Community Colleges, No. 118, Community College Faculty: Characteristics, Practices, and Challenges*, ed C. Outcalt (San Francisco, CA: Jossey-Bass), 9–20.

Pearce, J. L. (1993). Toward an organizational behavior of contract laborers: their psychological involvement and effects on employee co-workers. *Acad. Manage. J.* 36, 1082–1096. doi: 10.2307/256646

Rhoades, L., and Eisenberger, R. (2002). Perceived organizational support: a review of the literature. *J. Appl. Psychol.* 87, 698–714. doi: 10.1037/0021-9010.87.4.698

Schulz, S. D. (2009). Predicting job satisfaction among iowa community college adjunct faculty members: use and application of herzberg's motivation-hygiene theory. *Doctoral Dissertation, University of Iowa*. Available online at: http://lib.dr.iastate.edu/etd/10994/

Sonner, B. S. (2000). A is for adjunct: examining grade inflation in higher education. *J. Educ. Bus.* 76, 5–8. doi: 10.1080/08832320009599042

Tamres, L. K., Janicki, D., and Helgeson, V. S. (2002). Sex differences in coping behavior: a meta-analytic review and an examination of relative coping. *Pers. Soc. Rev.* 6, 2–30. doi: 10.1207/S15327957PSPR0601_1

Thompson, K. (2003). Contingent faculty and student learning: welcome to the stativersity. *New Dir. High. Educ.* 2003, 41–48. doi: 10.1002/he.119

Umbach, P. D. (2007). How effective are they? Exploring the impact of contingent faculty on undergraduate education. *Rev. High. Educ.* 30, 91–123. doi: 10.1353/rhe.2006.0080

Wayne, S. J., Shore, L. M., and Liden, R. C. (1997). Perceived organizational support and leader-member exchange: a social exchange perspective. *Acad. Manage. J.* 40, 82–111. doi: 10.2307/257021

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