Computers in Human Behavior xxx (2014) xxx–xxx

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Five days at outdoor education camp without screens improves preteen skills with nonverbal emotion cues

Yalda T. Uhls [a,*], Minas Michikyan [b], Jordan Morris [c], Debra Garcia [d,b], Gary W. Small [e], Eleni Zgourou [f], Patricia M. Greenfield [a]

[a] Department of Psychology, University of California, Los Angeles, Children's Digital Media Center @ LA, United States
[b] Department of Psychology, California State University, Los Angeles, Children's Digital Media Center @ LA, United States
[c] Department of Social Welfare, University of California, Los Angeles, United States
[d] Department of Education, University of California, Los Angeles, United States
[e] Department of Psychiatry & Biobehavioral Sciences, University of California, Los Angeles, United States
[f] Department of Education, University of North Carolina, Chapel Hill, Children's Digital Media Center @ LA, United States

ARTICLE INFO

Article history:
Available online xxxx

Keywords:
Social media
Nonverbal communication
Emotion
Adolescent
Social interaction
Development

ABSTRACT

A field experiment examined whether increasing opportunities for face-to-face interaction while eliminating the use of screen-based media and communication tools improved nonverbal emotion–cue recognition in preteens. Fifty-one preteens spent five days at an overnight nature camp where television, computers and mobile phones were not allowed; this group was compared with school-based matched controls ($n = 54$) that retained usual media practices. Both groups took pre- and post-tests that required participants to infer emotional states from photographs of facial expressions and videotaped scenes with verbal cues removed. Change scores for the two groups were compared using gender, ethnicity, media use, and age as covariates. After five days interacting face-to-face without the use of any screen-based media, preteens' recognition of nonverbal emotion cues improved significantly over those of the control group for both facial expressions and videotaped scenes. Implications are that the short-term effects of increased opportunities for social interaction, combined with time away from screen-based media and digital communication tools, improves a preteen's understanding of nonverbal emotional cues.

1. Introduction

For several millennia, humans' primary method for social learning and communication has been face to face. In the 21st century, as mobile technology and the Internet became available to most of the world's population (Internet world stats, 2013), digital media have become an increasingly prevalent factor in the informal learning environment (Greenfield, 2009). Children today, ages 8–18, spend over 7½ h a day, seven days a week using media outside of school (Rideout, Foehr, & Roberts, 2010). Moreover, teenagers, ages 12–17, report using phones to text message in their daily lives more than any other form of communication, including face-to-face socializing (Lenhart, 2012). The extensive time that children and teenagers engage with media and communicate using screens may be taking time away from face-to-face communication and some in-person activities (Giedd, 2012). Indeed, one longitudinal study found that the amount of non-screen playtime decreased 20% from 1997 to 2003, while screen activities (i.e., watching television, playing videogames and using the computer) increased (Hofferth, 2010).

The advent of mobile technology enables today's youth to access and engage with screens 24/7 outside of school while in cars, on vacations, in restaurants, and even in bed. A recent poll found that children's access to these kinds of devices has grown fivefold in the last two years (Common Sense Media, 2013). Extant research indicates that, today, media exposure begins at early ages, consumes the majority of youth leisure time, and takes place in many different environments and contexts. Such extensive use of new technology has raised concerns that children's face-to-face communication skills may be negatively affected (Bindley, 2011; Giedd, 2012).

1.1. Face-to-face and mediated communication

When engaging in face-to-face communication, social information is conveyed by vocal and visual cues within the context of the situation. Nonverbal communication, defined as communication

* Corresponding author. Address: Department of Psychology, University of California, Los Angeles, 616 Via De La Paz, Pacific Palisades, CA 90272, United States. Tel.: +1 310 526 3316; fax: +1 310 230 7830.

E-mail address: yaldatuhls@gmail.com (Y.T. Uhls).

http://dx.doi.org/10.1016/j.chb.2014.05.036
0747-5632/© 2014 The Authors. Published by Elsevier Ltd.

without words, includes apparent behaviors such as facial expression, eye contact, and tone of voice, as well as less obvious messages such as posture and spatial distance between two or more people (Knapp & Hall, 2010). The understanding of these kinds of nonverbal social cues is particularly important for social interaction because of the need to modify one's own behavior in response to the reactions of others (Knapp & Hall, 2010). The capability to effectively process emotional cues is associated with many personal, social and academic outcomes (Knapp & Hall, 2010; McClure & Nowicki, 2001). In addition, children who better understand emotional cues in a social environment may develop superior social skills and form more positive peer relationships (Blakemore, 2003; Bosacki & Astington, 1999).

Long before digital media became ubiquitous, investigators developed theories, such as the Cues-Filtered-Out theory, which postulated that the lack of nonverbal cues in computer-mediated interactions could lead to impersonal communication, (Culnan & Markus, 1987), while others pointed out deficits in computer-mediated communication due to the lack of social-context cues (Sproull & Kiesler, 1988). More recently, an experiment exploring the difference in emotional connectedness experienced by emerging adults using either in-person or digitally mediated communication showed that bonding and affiliative cues were significantly stronger when friends communicated in person rather than by text (Sherman, Michikyan, & Greenfeld, 2013). The extensive use of digital media, often text-based and thus inherently lacking nonverbal emotional cues, may thus curtail the face-to-face experiences necessary to master important social skills, even though they are used for social communication (Giedd, 2012).

1.2. The video deficit

Research regarding what children do and do not learn about the social world through screen-based media, in particular television, is robust (Guernsey, 2011; Richert, Robb, & Smith, 2011; Wartella, 2012; Wartella, O'Keefe, & Scantlin, 2000). Much of the research concentrates on early learning from imitation, socially contingent interaction (e.g. joint attention and gaze following), and word learning (Flom & Johnson, 2010; Moore & Dunham, 1995). This body of research shows that young children learn better from live interaction than from screens. For example, Hayne, Herbert, and Simcock (2003) performed a series of experiments using matched live and videotaped models who performed a series of actions with a rattle and stuffed animals. Although children imitated televised models, the mean imitation scores were significantly higher in the live condition. This discrepancy in imitation appears to last until 30 months of age and was coined the "video deficit."

1.3. Reading nonverbal emotion cues: processes of development and learning

Features of face-to-face communication such as eye contact and pointing are crucial when teaching young children about social interaction and the world they live in. For example, gaze following, a well-studied mechanism in the literature on human development, guides infants from around one year of age to learn about objects and humans (Flom & Johnson, 2010). Humans also learn from cues such as pointing when interacting socially (Moore & Dunham, 1995). Once a child is able to attend to an object that another person highlights, their ability to learn through social interaction increases. These means of learning are available only when a child can see another's face and physical being (Gross & Ballif, 1991).

In-person interaction also develops the accurate understanding of nonverbal emotion cues. For instance, cooperative interaction among siblings in the third year of life has been shown to predict skill in affective labeling of facial expressions and understanding of emotions in dramatized puppet scenarios in the fourth year of life (Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991). The children's positive behavior toward their siblings in the third year of life continued to predict more advanced understanding of emotions at six years of age (Brown & Dunn, 1996). These longitudinal findings point to in-person peer interaction as a key learning experience in the early acquisition of skill in reading nonverbal emotion cues.

As children grow older, their peer focus shifts from siblings to unrelated peers, whom they usually meet in school. In preadolescence, the period under investigation in the present research, social interaction skill with peers, assessed in an in-person school situation, was correlated with an understanding of feelings presented in narrative (Bosacki & Astington, 1999).

2. Research question and hypothesis: the present study

In the present study, we designed a field experiment to ask the research question: Does children's frequent screen use—and the possibility that this extensive use replaces critical face-to-face communication—promote the development of emotion understanding to the same extent as in-person interactions? If not, a shift in children's activities to solely in-person peer and adult communication could enhance skill in understanding the emotions of other people.

Our experimental condition was a naturally occurring environment where children experienced extensive opportunities for social interaction, combined with no access to screens, for five days. Our participants were preteens in the sixth grade. We chose this age group because: (1) by the time they reach early adolescence, children are able to integrate information from many nonverbal cues, including face, gesture and tone, to make inferences about social situations (Knapp & Hall, 2010); (2) the understanding of social emotions and the ability to take into account another person's perspective are some of the most dramatic changes during adolescence (Dumontheil, Houlton, Christoff, & Blakemore, 2010); and (3) this is an age when many children begin to access personal mobile technology and media use peaks (Rideout et al., 2010).

We investigated whether an absence of screens, and, accordingly, increased opportunities for face-to-face communication, gave children the context to be more sensitive in comprehending nonverbal emotion cues. Our hypothesis was that, relative to a matched control group that continued their usual daily activities -including screen-based activities- both in and outside of school, children's skill at recognizing emotion from nonverbal cues would improve after five days of increased opportunity for face-to-face interaction in an environment without screens.

3. Method

3.1. Design and Participants

The study design involved a pre- and post-test, and a no-intervention matched control group. Both the experimental and control (i.e., no-intervention) groups were comprised of sixth graders recruited from the same public school in Southern California. The experimental group included 51 children from the Spring 2012 class, and the control included 54 children from the Fall 2012 class. Given that the two groups attended the same public school, the groups were drawn from the same population and therefore matched on many important demographic variables. In an average day of the week during the school year, both groups reported spending approximately 4 1/2 h a day outside of school texting, watching television, and playing videogames (see Table 1 for key demographic variables for both groups).

Please cite this article in press as: Uhls, Y. T., et al. Five days at outdoor education camp without screens improves preteen skills with nonverbal emotion cues. *Computers in Human Behavior* (2014), http://dx.doi.org/10.1016/j.chb.2014.05.036

The experimental group participated in the Pali Institute, an outdoor education overnight camp facility, located 70 miles outside of Los Angeles, where neither electronic devices nor access to any kind of screens was permitted. Opportunities for face-to-face social interaction included living together in cabins, going on hikes together, and working as a team to build emergency shelters. Our choice to use the camp as an intervention, rather than ask children to stop using media on their own or bring them into a lab environment, was a deliberate strategy that provided control, as well as ecological and external validity.

The camp is educational; schoolchildren spend the day immersed in activities meant to teach science through outdoor instruction (see Table 2 for a description of the daily activities). The school signed up their entire sixth-grade cohort to attend the camp (and planned for the control group to attend in the Spring of 2013), and thus there was virtually no self-selection. In choosing the control group, we considered other groups, such as an overnight camp that integrated screens into the daily activities, but we determined that the selection effects outweighed the benefits of matching on the overnight experience; in other words, children who are interested in these kinds of technology-oriented camps, and whose parents could afford the cost (e.g., currently, UCLA Tech overnight camps are approximately $2000 for one week), would not be a good match for children who were sent to an outdoor nature camp underwritten by a public school district. In addition, the children's social network was controlled for, because the same children were together at camp with their peers from their sixth-grade classes at school.

Participants in the control group attended school, with a typical week of instruction at a California public elementary school (i.e., history, English, math instruction, etc.), each day between the pre- and post-test with no restrictions placed on their media use by our research team. While we did not collect information about after school, beyond asking children about their typical day's media activities, a teacher at the school polled her class and shared with us that the majority of the children participate in sports two to four times a week. UCLA's Institutional Review Board approved this study.

3.2. Measures

Participants in both conditions began by taking a one-time online media-use survey to measure their daily media activities. We created this Media Use Questionnaire using items from pre-existing surveys (Pea et al., 2012; Uhls, 2013). In order to create a media-use variable to employ as a covariate, we added together the amount of time during an average school day participants reported spending on computers, television, video games, and cell phones. For computers and cell phones, amount of time was calculated by summing amount of time reported for specific activities using these media (e.g., video chatting, texting, posting videos). This measure was used as a control in our analysis.

After comprehensive piloting, for our dependent variables, we chose two well-validated tests, also extensively tested with children, to assess the ability to decode emotional nonverbal communication. Because the ability to accurately read emotion in the facial expression of others is one of the most important nonverbal communication skills, we used the Faces subtests of the second edition of the Diagnostic Analysis of Nonverbal Behavior (DANVA2) (Nowicki & Carton, 1993). This test has been validated with participants differing in age, gender, ethnicity, intellectual ability and cultural background in over 385 studies (Nowicki, 2010). The Faces subtest includes 48 photos of faces (24 children and 24 adults) with happy, sad, angry, and fearful emotions in both high and low intensity. These photos of children and adult faces were each flashed onto a screen for 2 s after which participants recorded on a sheet the emotion the actor exhibited. Scoring assessed the number of errors made in the identification of emotions. Approximately half the children in the control group and half the children in the experimental group were given adult faces first; the other half in each group were given the child faces first.

Our second test examined children's ability to integrate and accurately interpret different kinds of nonverbal cues within a setting that more clearly reflected real life. The Child and Adolescent Social Perception Measure (CASP), a measure that has been validated for several different populations (Clikeman-Semrud, Walkowiak, Wilkinson, & Minne, 2010; Guiltner, 2000; Magill-

Table 1
Key demographics for the experimental and control groups.

	Camp	Control
Sample size and gender	51 (25 Boys; 26 girls)	54 (26 Boys; 28 girls)
Age (yrs; mean ± SD)	11.86 ± .46	11.81 ± .52
	Range 11–13	Range 11–13
Ethnicity*	White 26 (51%)	White 11 (20%)
	Hispanic 9 (18%)	Hispanic 9 (17%)
	African American 1 (2%)	African American 1 (2%)
	Asian 9 (17%)	Asian 19 (35%)
	Other/mixed 6 (12%)	Other/mixed 14 (26%)
Parents' education	Mother:	Mother:
	Finished high school 5 (10%)	Finished high school 7 (12%)
	Some college 10 (20%)	Some college 10 (18%)
	Finished college 15 (29%)	Finished college 21 (37%)
	Beyond college 6 (12%)	Beyond college 5 (9%)
	Father:	Father:
	Finished high school 6 (12%)	Finished high school 9 (16%)
	Some college 9 (17%)	Some college 7 (12%)
	Finished college 18 (35%)	Finished college 21 (37%)
	Beyond college 5 (10%)	Beyond college 3 (5%)
Media use/ownership	22 (43%) Own phone	26 (48%) Own phone
	51 (100%) Computer at home	52 (96%) Computer at home
Media use (mean ± SD) hours per school day	Texting: .9 ± 1.3	Texting: 1.1 ± 1.6
	Watching TV: 2.4 ± 1.4	Watching TV: 2.1 ± 1.6
	Playing video games: 1.2 ± 1.3	Playing video games: 1.4 ± 1.4

Note: no variables were significantly different between experimental and control groups except for *ethnicity: $t_{(105)} = -2.95$, $P < 0.01$. However, ethnicity was not correlated with change scores on the dependent variables. Percentages of parents' education do not total 100% because some subjects did not know their parents' educational history.

Please cite this article in press as: Uhls, Y. T., et al. Five days at outdoor education camp without screens improves preteen skills with nonverbal emotion cues. *Computers in Human Behavior* (2014), http://dx.doi.org/10.1016/j.chb.2014.05.036

Table 2
Sample list of classes in a day at Pali Institute.

Class name	Description
Forest ecology	Students hike through the forest to explore and learn about the ecosystems around them. They identify flora and fauna and participate in hands-on activities. Through these various activities, students understand the history of the forest as the ecosystems come alive before their eyes
Outdoor skills	Mixing nature's beauty with outdoor survival, students learn the Ten Essentials for any outdoor trip. They learn fire-building and cooking food in an outdoor setting. While in the forest, they will band together as a team to build emergency shelters. By the end of this class, students understand basic principles of exploring the great outdoors
Animal survivor	Students are taught the importance and dynamics of food chains/webs and how species depend on one another for survival. In a fast-paced activity, students are assigned an identity: carnivores, herbivores or omnivores. They must search for food while avoiding predators (their peers). Each student begins the game with a certain number of lives and must have at least one life remaining at the end to be a "survivor"
Day hike	Schools have the opportunity to select their focus for a hike, such as birding, visiting a nature center and greenhouse, or shortened versions of a double-session forest ecology or outdoor skills class
Archery	Students learn the history and mechanics of archery, one of the oldest arts and means for survival. They are introduced to the basic physics of a bow and arrow, as well as the proper handling of this ancient device. With this knowledge, they participate in target shooting. Students gain an understanding of the importance of archery and its influence on society
Orienteering	Students find their sense of direction while engaging in one of several orienteering courses. During the expedition, they learn how to navigate through the forest by using compasses and coordinates. They gain an understanding of the various skills involved in planning travel from point A to point B

Note: (each lesson approximately 90 min); link to curriculum for Pali Mountain outdoor education program: <http://www.paliinstitute.com/oe.html>.

Evans, Koning, Cameron-Sadava, & Manyk, 1995), assesses the social perception skills of children and adolescents using ten videotaped scenes in which actors (children and adults) perform a representative scenario in different situations typical of an adolescent's life (e.g., school, home) (Magill-Evans et al., 1995). In each scene, the verbal content is removed, requiring participants to receive and interpret nonverbal social cues without speech cues. After watching the videotaped scenes, the test-taker is asked to make a judgment about the emotional states of the actors.

To adapt the CASP for our design, we randomly separated the videos into sets of five. The two sets were counterbalanced as pretest and posttest in both the control and experimental groups. Children watched each of the five videos in sequence and were given several minutes to record a written description of the emotions of each actor before moving on to the next one. These forms were then scored.

We used the existing coding system of the CASP to create a total emotion score based on the sum of number of accurate, partially correct, or wrong answers for each character and scene. A participant was given two points for each correctly identified emotion, one point for a partially correct identification, and zero for an incorrect identification or no identification. Different videos had different numbers of actors; in some videos an actor would manifest more than one emotion in different parts of the scene. Therefore, the maximum score varied from video to video. Because the maximum score on one form was 41, whereas the maximum score on the other form was 45, for our analysis, all scores were converted into percentages, so that change scores would be comparable across both orders of administration.

The forward Digit Span (Wechsler, 2004) a subset of the Wechsler Intelligence Scale for children, was administered as a distracter task between the CASP and the DANVA2.

3.3. Procedure

3.3.1. Experimental group

Upon arrival to the camp on a Monday morning, and immediately after exiting the school bus, the entire sixth-grade class took the media use survey. Next, children were randomly assigned to one of two administration groups to take the pre-test. A moderator in each group followed a scripted protocol to administer each test. In both groupings, children completed the DANVA2 and watched five videos from the CASP, with the distracter task in-between the measures. Group 1 first completed the DANVA2, followed by the Digit Span, and next the CASP; whereas Group 2 first completed the CASP, followed by the Digit Span, and concluded with the DANVA2.

The post-test was also administered at the camp, on the Friday immediately before the children mounted school buses for their ride home. Children stayed in the same groups that were assigned for the pre-test. We followed the same procedure of testing as in the pre-test but did not re-administer the media use survey.

3.3.2. Control group

Children were kept with their classes (each class was one group). Testing occurred on Monday and Friday at approximately the same time of school day as during the camp. We followed the same procedure for administering the tests for the control as we did for the experimental.

In both the experimental and control groups, we counterbalanced the testing order across two administration groups and pre and post-tests (i.e., adult or children faces first for the DANVA2 and set one or set two of the CASP videos).

3.4. Analysis

We began our analysis by conducting independent-sample *t*-tests to compare each administration group within condition on key socio-demographic characteristics, dependent variables at pre-test, media use and social variables. Finding no significant differences, we combined data from the two administration groups and next conducted the same analysis to confirm equivalent sociodemographic characteristics and media use across conditions. We found only one significant difference between the experimental and control condition; and that was a difference in ethnic composition ($t_{(105)} = -2.95$, $P < 0.01$) (see Table 1 for ethnic breakdown in each group). Following up this significant difference, we ran a correlational analysis to determine whether ethnicity was related to any of the dependent variables; it was not, and thus was not considered a significant factor in our analysis.

Statistical literature indicated that the reliability of gain scores is higher than other variables in many practical situations with designs similar to our experiment (i.e., nonrandomized control group pretest and posttest designs); thus we chose change scores as our dependent variable (Dimitrov & Rumrill, 2003). We calculated change scores by measuring the difference between pretest and posttest scores on each measure.

The DANVA change scores were calculated by subtracting posttest errors from pretest errors and ranged from −10 to 31 with positive numbers showing error reduction. The CASP change scores were calculated by subtracting the total emotion percentage correct on the pretest from the total emotion percentage correct on the posttest and ranged from −14% to 31% with positive numbers showing improvement in the total emotion percentage correct. Three coders achieved inter-rater reliability on 20% of the CASP responses (Cronbach's alpha = .93).

We used these scores to investigate potential differences between the experimental and control condition for both the DANVA2 and CASP. For both dependent variables, we ran univariate analyses of covariance, the preferred method of analysis for this design (Dimitrov & Rumrill, 2003), using gender, ethnicity, and age, as well as a composite variable called media-use sum (i.e., sum of time spent watching television, playing video games, using cell phones, and using computers) as covariates, in order to control for demographics and prior media use.

4. Results

We found that children who were away from screens for five days with many opportunities for in-person interaction improved significantly in reading facial emotion (DANVA 2), compared to those in the control group, who experienced their normal media exposure during an equivalent five-day period ($F_{5,88} = 4.06$, $p < .05$, $d = .33$). In the experimental condition, participants went from an average of 14.02 errors in the Faces pretest (including both child and adult faces) to an average of 9.41 errors in the posttest (a reduction of 4.61 errors), while the control group went from and average of 12.24 to 9.81, which was a reduction of 2.43 errors (we attribute this change to a practice effect). Thus, the group that attended camp without access to any screen-based media improved significantly more than the control group, who experienced their usual amount of screen time. Fig. 1 illustrates these change scores.

We found a similar effect when using the videotaped scenarios (CASP). Ability to correctly identify the emotion of actors was significantly greater for the children who had experienced five days of camp without personal media than for the control group ($F_{5,86} = 8.75$, $p < .01$, $d = .66$). In the experimental condition, scores improved between pre- (i.e. $M = 26\%$ correct) and post-test (i.e. $M = 31\%$ correct); in the control group, children's scores stayed flat at 28% correct on pre- and posttest. Thus, children in the experimental group showed significant improvement in their ability to recognize the nonverbal emotional cues in videotaped scenes, while the emotion-reading cues of the control group showed no change between pretest and posttest.

5. Discussion

In today's world, digital media use begins at a very early age (Common Sense Media, 2013) and takes up a large proportion of the informal learning environment (Greenfield, 2009), making it essential to assess the effects of the substantial amount of time children engage with media. This study provides evidence that, in five days of being limited to in-person interaction without access to any screen-based or media device for communication, preteens improved on measures of nonverbal emotion understanding, significantly more than a control group.

We recognize that the design of this study makes it challenging to tease out the separate effects of the group experience, the nature experience, and the withdrawal of screen-time; but it is likely that the augmentation of in-person communication necessitated by the absence of digital communication significantly contributed to the observed experimental effect. In other words, the time the participants spent engaging with other children and adults face-to-face seemed to make an important difference. The absence of screens meant children could rely only on face-to-face interaction when communicating during camp activities. Accordingly, the results suggest that digital screen time, even when used for social interaction, could reduce time spent developing skills in reading nonverbal cues of human emotion.

Another possibility for the observed effect is that nature activities could have caused the improvement in reading emotions communicated through nonverbal cues. While other studies have demonstrated the cognitive benefits from interacting with nature (Atchley, Strayer, & Atchley, 2012; Berman, Jonides, & Kaplan, 2008) it is counterintuitive (and counter to the research on communicative learning) that being in nature, which is not an inherently social activity and often is more isolating than urban settings, could help someone learn to understand the emotions of other individuals.

Our findings are in line with developmental research pointing to the importance of in-person peer interaction as a learning process that leads to skill in understanding the emotions of others (Bosacki & Astington, 1999). These results are also in line with findings in neuroscience. For example, recent brain imaging with adult participants showed that the neural synchronization during face-to-face dialog does not exist when communicating back to back (Jiang et al., 2012).

5.1. Limitations and future research

As mentioned above, a limitation to our study is that we cannot disentangle the effects of the three factors: the group experience, the nature experience, and the absence of screens, as these variables were all features of the experimental condition. We hypothesize that the effect of being in a setting that included potentially more opportunities for face-to-face group interaction than were afforded in the control group was the critical factor. But even without being able to delineate all the conditions under which social skill improvement would take place, this experiment does suggest that day-to-day, media-saturated environments interfere with a preteen's understanding of face-to-face communications, while rich opportunities for in-person social interaction enhance understanding of nonverbal emotion cues.

A next step is to attempt to generalize our findings by testing the effects of eliminating screen time in the presence of a different set of activities, to determine whether withdrawing media exposure or adding daily face-to-face interactions underlies the improvement in recognizing nonverbal emotion cues. Because skill in reading emotional cues is essential to an individual's ability to function in society (Gross & Ballif, 1991) further research is called for. In addition, it would be important to understand the extent to which these kinds of effects are lasting; one would expect that it would be necessary to reduce screen time and increase face-to-face

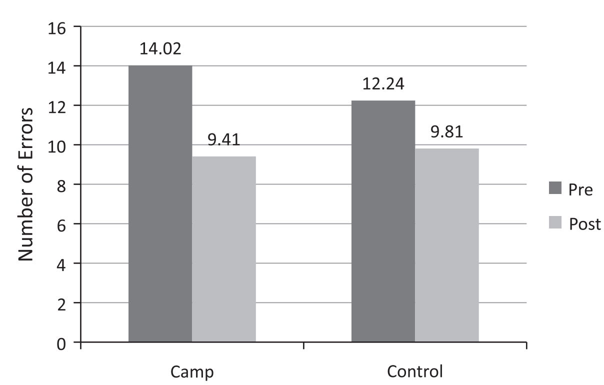

Fig. 1. Error reduction from pretest to posttest in assessing emotion on DANVA2 faces in experimental and control group ($F_{5,88} = 4.06$, $p < 0.05$).

Please cite this article in press as: Uhls, Y. T., et al. Five days at outdoor education camp without screens improves preteen skills with nonverbal emotion cues. *Computers in Human Behavior* (2014), http://dx.doi.org/10.1016/j.chb.2014.05.036

time on an ongoing basis in order to maintain or build on the effects demonstrated in this short-term field experiment.

6. Conclusions

The results of this study should introduce a much-needed societal conversation about the costs and benefits of the enormous amount of time children spend with screens, both inside and outside the classroom. Given that a pre-requisite for effective socialization is learning and practicing how to communicate with others in person (Eder & Nenga, 2003), face-to-face experiences must be emphasized in the socialization process. While digital media provide many useful ways to communicate and learn, our study suggests that skills in reading human emotion may be diminished when children's face-to-face interaction is displaced by technologically mediated communication. Today, even children under 2 years of age use mobile devices (Common Sense Media, 2013). Moreover, computers and mobile tablets are rapidly entering classrooms and being put in the hands of every child beginning as early as kindergarten (Partnership for 21st Century Skills, 2009; Rotella, 2013) without sufficient attention to the potential costs (Cuban, 2001). Our hope is that this study will be a call to action for research that thoroughly and systematically examines the effects of digital media on children's social development.

Author contributions are as follows. YTU, GS and PMG came up with the idea. YTU and PMG developed and designed study. YTU, MM, DG and PMG piloted the study and developed group protocols for the measures. YTU, MM, JM, DG and EZ ran participants. YTU, MM, JM, DG and EZ coded data. YTU, MM and PMG developed and/or ran data analyses. YTU and PMG wrote the manuscript. All authors read and offered criticism of the manuscript.

Acknowledgements

We thank Andy Wechsler, Jolie Nelson and Michael Urbach at Pali Institute for welcoming our study at their outdoor camp. We also express our appreciation to the counselors who helped us and to the campers who participated in the research, as well as the school, the teachers, administrators, parents and students. Thank you to research assistant Christine Clemmons for helping with pilot testing and to Bridget Roy for helping run participants and code the CASP. All participants who contributed substantially to the study are listed in these acknowledgments.

References

Atchley, R. A., Strayer, D. L., & Atchley, P. (2012). Creativity in the wild: Improving creative reasoning through immersion in natural settings. *PLoS ONE, 7*(12).

Berman, M. G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological Science, 19*, 1207–1212.

Bindley, K. (2011). When Children text all day, what happens to their social skills? *Huffingtonpost.com*. <http://www.huffingtonpost.com/2011/12/09/children-texting-technology-social-skills_n_1137570.html> (Retrieved 13.03.13).

Blakemore, S. J. (2003). How does the brain deal with the social world? *Neuro Report, 14*, 1–10.

Bosacki, S., & Astington, J. W. (1999). Theory of mind in preadolescence: Relations between social understanding and social competence. *Social Development, 8*, 237–255. http://dx.doi.org/10.1111/1467-9507.00093.

Brown, J. R., & Dunn, J. (1996). Continuities in emotion understanding from three to six years. *Child Development, 67*, 789–802. doi: 10.1111/j.1467-8624.1996.tb01764.x.

Clikeman-Semrud, M., Walkowiak, J., Wilkinson, A., & Minne, E. P. (2010). Direct and indirect measures of social perception, behavior and emotional functioning in children with Asperger's disorder, nonverbal learning disability, or ADHD. *Journal of Abnormal Child Psychology, 38*, 509–519.

Common Sense Media. (2013). *Zero to Eight: Children's media use in America*. <http://www.commonsensemedia.org/research/zero-to-eight-childrens-media-use-in-america-2013>.

Cuban, L. (2001). *Oversold and underused*. Cambridge, MA: Harvard University Press.

Culnan, M., & Markus, M. (1987). Information technologies. In F. Jablin, L. Putnam, K. Roberts, & L. Porter (Eds.), *Handbook of organizational communication* (pp. 420–443). Newbury Park, CA: Sage.

Dimitrov, D. M., & Rumrill, P. D. (2003). Pretest–posttest designs and measurement of change. *IOS Press, 20*, 159–165.

Dumontheil, I., Houlton, R., Christoff, K., & Blakemore, S. J. (2010). Development of relational reasoning during adolescence. *Developmental Science, 13*, F15–F24. http://dx.doi.org/10.1111/j.1467-7687.2010.01014.x.

Dunn, J., Brown, J., Slomkowski, C., Tesla, C., & Youngblade, L. (1991). Young children's understanding of other people's feelings and beliefs: Individual differences and their antecedents. *Child Development, 6*, 1352–1366. doi: 0.1111/j.1467-8624.1991.tb01610.x.

Eder, D., & Nenga, S. K. (2003). Socialization in adolescence. In J. Delamater (Ed.), *Handbook of social psychology* (pp. 157–175). New York: Kluwer Academic/Plenum Publishers.

Flom, R., & Johnson, S. (2010). The effects of adults' affective expression and direction of visual gaze on 12-month-olds' visual preferences following a 5 minute, 1-day or 1-month delay. *British Journal of Developmental Psychology, 29*, 64–85.

Giedd, J. N. (2012). The digital revolution and adolescent brain evolution. *Journal of Adolescent Health, 51*, 101–105.

Greenfield, P. M. (2009). Technology and informal education: What is taught, what is learned. *Science, 323*, 69–71.

Gross, A. L., & Ballif, B. (1991). Children's understanding of emotion from facial expression and situations: A review. *Developmental Review, 11*, 368–398.

Guernsey, L. (2011). *Screentime: How electronic media – from baby videos to educational software – affects your child*. Basic Books.

Guiltner, V. D. (2000). *Validation of the child and adolescent social perception measure*. Edmonton, Alberta: Department of Education Psychology.

Hayne, H., Herbert, J., & Simcock, G. (2003). Imitation from television by 24- and 30-month-olds. *Developmental Science, 6*, 254–261.

Hofferth, S. L. (2010). Home media and children's achievement and behavior. *Child Development, 81*, 1598–1619.

Internet world stats. (2013). *Internet World Stats*. <http://www.internetworldstats.com/stats.htm>.

Jiang, J., Dai, B., Peng, D., Zhu, C., Liu, L., & Lu, C. (2012). Neural synchronization during face-to-face communication. *The Journal of Neuroscience, 32*, 16064–16069. doi:10:1523/JNEUROSCI.2926-12.2012.

Knapp, M. L, & Hall, J. A (2010). *Nonverbal communication in human interaction (Seventh.)*. Boston, MA: Wadsworth Cengage Learning.

Lenhart, A. (2012). *Teens, smartphones and texting*. Washington DC: Pew Research Center.

Magill-Evans, J., Koning, C., Cameron-Sadava, A., & Manyk, K. (1995). The child and adolescent social percetion measure. *Journal of Nonverbal Behavior, 19*, 151.

McClure, E., & Nowicki, S. Jr., (2001). Associations between social anxiety and nonverbal processing skill in preadolescent boys and girls. *Journal of Nonverbal Behavior, 25*, 3–19.

Moore, C., & Dunham, P. J. (Eds.). (1995). *Joint attention: Its origins and role in development*. Hillsdale, NJ: Erlbaum.

Nowicki, S. Jr., (2010). *Manual for the receptive tests of the DANVA2*.

Nowicki, S., & Carton, J. (1993). The measurement of emotional intensity from facial expressions. *The Journal of Social Psychology, 133*, 749–750.

Partnership for 21st Century Skills. (2009). 21st Century student outcomes. Washington DC.

Pea, R., Nass, C., Meheula, L., Rance, M., Kumar, A., Bamford, H., et al. (2012). Media use, face-to-face communication, media multitasking, and social well-being among 8–12 year old girls. *Developmental Psychology, 48*, 327–336. http://dx.doi.org/10.1037/a0027030.

Richert, R. A., Robb, M., & Smith, E. I. (2011). Media as social partners: The social nature of young children's learning from screen media. *Child Development, 82*, 82–95.

Rideout, V. J., Foehr, U. G., & Roberts, D. F. (2010). *Generation M2: Media in the lives of 8–18 year-olds*. Menlo Park, CA: Kaiser Family Foundation.

Rotella, C. (2013). No child left untableted. *New York Times*. NYC, NY. <http://www.nytimes.com/2013/09/15/magazine/no-child-left-untableted.html?_r=0>.

Sherman, L. E., Michikyan, M., & Greenfeld, P. M. (2013). The effects of text, audio, video, and in-person communication on bonding between friends. *Cyberpsychology: Journal of psychosocial research on cyberspace, 7*. Article 3. http://dx.doi.org/10.5817/CP2013-2-3.

Sproull, L., & Kiesler, S. (1988). Reducing social context cues: Electronic mail in organizational communication. *Management Science, 32*, 1492–1512.

Uhls, Y. (2013). *Values and new media: How social media relates to preteen values*. Seattle, Wa: Presented at the Society for Research on Child Development.

Wartella, E. (2012). The influence of media on young children's development. *Zero to Three*, 18–22.

Wartella, E., O'Keefe, B., & Scantlin, R. (2000). *Children and interactive media: A compendium of current research and directions for the future*. Markle Foundation.

Wechsler, D. (2004). *The Wechsler Intelligence Scale for children*. Pearson Assessment.