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Nonverbal Affiliation by Physician Assistant Students during Simulated Clinical Examinations: Genotypic Effects

Kory Floyd, Mark Alan Generous, & Lou Clark

In the relationship between patients and health care providers, the use of nonverbal affiliative behaviors—including smiling, facial expressiveness, and a lack of dominance—is associated with multiple benefits to patient satisfaction, compliance, and health. However, little is known about what accounts for variance in providers' tendencies to enact nonverbal affiliative behaviors during routine patient encounters. The present exploratory study examines nonverbal affiliative behaviors by physician assistant students in interactions with standardized patients. Each student conducted three clinical interviews over a 6-month period, each of which was coded for a cadre of nonverbal affiliative behaviors. Students also provided saliva samples for genotyping six single-nucleotide polymorphisms on the oxytocin receptor gene (OXTR) *that are linked empirically to affiliation and other prosocial behaviors. Consistent with recent research, this study adopted a cumulative risk approach wherein students were scored for their number of risk alleles on the single-nucleotide polymorphisms. Results indicated that cumulative risk on the oxytocin receptor gene significantly predicted four out of five nonverbal affiliative behaviors.*

Keywords: Affiliation; Nonverbal Behavior; Oxytocin Receptor Gene; Patient–Provider Communication; Physician Assistants; Single-Nucleotide Polymorphisms

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Although some have argued that the relationship between patients and health care providers is fundamentally instrumental and *im*personal (e.g., Burgoon, 1992), many scholars have documented the virtues of health care providers interacting with patients *inter*personally (e.g., Lipp et al., 2016). Adopting an interpersonal frame for provider–patient interaction includes expressing to patients messages that convey a sense of respect, appreciation, compassion, and caring, many of which are encoded through nonverbal affiliative behaviors.

Affiliative behavior is consequential in many provider–patient relationships, but perhaps particularly in the context of primary care. Whereas several studies have examined forms of prosocial communication from physicians (see Roter & Hall, 2006), an increasing number of patients instead receive primary care from physician assistants (PAs). Few studies have examined affiliative communication by physician assistants, and none has yet addressed the genetic antecedents of nonverbal affiliative behavior in physicians, physician assistants, or students training for those professions.

This paper proposes that significant proportions of the variance in nonverbal affiliative ability may be explained in part by variation in communicators' genetic characteristics. The literature review begins by describing research on affiliative behavior in general, and then identifies some of its most consequential outcomes in the health care context, concluding that review with the observation that although much is known about the *consequences* of nonverbal affiliative behavior in the health care context, very little is known about the *antecedents* of such behavior. We then describe research on the genetic origins of nonverbal affiliative communication and present the current study's hypotheses.

Affiliative Behavior

Affiliation can be thought of as indexing attempts to become connected or associated with others, and various theoretic perspectives speak to its primacy as a human social motivation. For instance, Baumeister and Leary (1995) argued persuasively that humans have an evolutionarily adaptive need to belong that motivates the formation and maintenance of interpersonal attachments (see also affection exchange theory, Floyd, 2006). Similarly, Dillard and Solomon's relational framing theory (RFT: Dillard, Solomon, & Palmer, 1999; Dillard, Solomon, & Samp, 1996; Solomon, Dillard, & Anderson, 2002) provides that all social interactions tend to be framed either in terms of affiliation or in terms of dominance, and that these are competing, rather than complementary, frames. According to RFT, that is, individuals evaluate a social situation either in terms of how affiliative/disaffiliative it is, or in terms of how dominant/submissive it is. Other models, such as the interpersonal circumplex model (Horowitz, 2004; Horowitz et al., 2006; Wiggins, 1982), also juxtapose affiliation and dominance as superordinate dimensions of human interpersonal interaction. According to multiple perspectives, therefore, affiliation is a fundamental component of interpersonal interaction, and one that is relevant for understanding communication in a variety of contexts.

Behaviorally, affiliation tends to be communicated via behaviors that convey friendliness, openness, and engagement with and interest in others. Although these include verbal expressions of interest and affection, they also include nonverbal affiliation cues such as smiling, emotional expressivity, proximity, immediacy, warmth, and a lack of dominance (see Burgoon, Guerrero, & Floyd, 2010; Kogan et al., 2011; Richmond, McCroskey, & Johnson, 2003). Some affiliation behaviors may be more common or more applicable in certain contexts than in others, and some behaviors—such as touch—can encode affiliative messages in a close relationship, but instrumental messages in a professional relationship (e.g., with a massage therapist), or even aggressive messages in a competitive relationship (e.g., with an athletic rival).

The focus of the present investigation is on the use of affiliative behaviors in the health care context, specifically, interactions between health care providers and patients. As described subsequently, much existing research on the topic has focused on the behaviors of physicians and nurses. In this study, we extend that focus to the behaviors of students training for careers as physician assistants (PAs), due to their ubiquity in primary care.

Affiliative Communication by Health Care Providers

As the following sections detail, several studies have examined the consequences of prosocial and affiliative communication by health care providers. Considered collectively, this research confirms the benefits of providers' affiliative behavior on a variety of outcomes for patients, including satisfaction with providers, compliance with medical regimens, and health.

Satisfaction

As Kiesler and Auerbach (2003) pointed out, the most common outcome adjudicated in research on patient–provider interaction has been patients' satisfaction with their providers. This research has been fairly consistent in its conclusion that higher levels of provider affiliative behavior are associated with greater patient satisfaction with their providers and their health care (for reviews, see Beck, Daughtridge, & Sloane, 2002; Di Blasi, Harkness, Ernst, Georgiou, & Kleijnen, 2001). This is true whether providers enact affiliation verbally (Aruguete & Roberts, 2000; Young & Klingle, 1996) or nonverbally (Bensing, 1991; Bertakis, Roter, & Putnam, 1991). More recent research by Cousin and Mast (2013) has demonstrated that the contribution of physician affiliative behavior to patient satisfaction is moderated by patients' level of agreeableness, such that highly agreeable patients benefit more from physician affiliation than do their less agreeable counterparts (see also Campbell, Auerbach, & Kiesler, 2007; Mast, Hall, Klöckner, & Choi, 2008). A separate study (Cousin & Mast, 2016) replicated that pattern in the context of physicians delivering negative medical news.

Compliance

A second important outcome for patients is their adherence to prescribed medical regimens, such as directives to take medication or enact lifestyle changes. Meta-analytic work confirms that, in general, the quality of physician communication is positively correlated to patient compliance (see Zolnierek & DiMatteo, 2009). The evidence related to affiliative behavior, specifically, is somewhat less consistent for compliance than for satisfaction, with some studies showing that greater compliance with physicians' directions is associated with higher physician affiliative behavior (Cecil & Killeen, 1997) or physician empathy (Kim, Kaplowitz, & Johnston, 2004) and others showing no association (Hall, Roter, & Katz, 1988). Some scholars have suggested that affiliative behavior—especially nonverbal—on the part of providers creates an *interpersonal*, rather than merely professional, bond with patients within which providers can motivate compliance by exerting authority and dominance (see, e.g., Kaplan, Greenfield, & Ware, 1989).

Health

Finally, providers' affiliative behavior can influence certain health outcomes for patients. For instance, breast cancer patients experienced better psychological adjustment when their physicians enacted high-affiliation behavior (Roberts, Cox, Reintgen, Baile, & Gibertini, 1994). Similarly, diabetic patients had better metabolic control (in the form of lower HbA_{1c}) when their doctors displayed greater empathy (Hojat et al., 2011) and when their nurses were more patient-centered and less controlling (Street et al., 1993). Rakel et al. (2011) also found that patients with highly empathic physicians showed decreased duration and severity of common cold symptoms than patients with less empathic doctors. Kaplan et al. (1989) similarly reported that patients have better functional status and fewer physiological indicators of disease when they perceive that they have more control over their patient–provider interactions compared to physicians (i.e., lack of physician dominance; for reviews, see Stewart, 1995; Stewart et al., 1999).

Overall, research supports the valuable *consequences* of affiliative communication abilities for health care providers, yet comparatively little is known about the *predictors* of such abilities. Are all health care providers equally capable of being affiliative? If not, what accounts for variance in their skills? Whereas most studies have focused on the utility of provider communication skills training programs and interventions (see, e.g., Cegala & Lenzmeier Broz, 2002), less empirical attention has been paid to the possibility that affiliative communication behavior may have genetic antecedents. We address this possibility subsequently.

Genetic Predictors of Nonverbal Affiliation Behavior

Some studies—although none focused on health care providers prior to the current investigation—have explored a possible genetic basis for affiliative, prosocial nonverbal behavior. Substantial proportions of the variance (≥50%) in prosocial *personality traits*,

such as positive emotionality, openness, and extraversion, are genetically heritable (Bouchard, 2004), so it is not unreasonable to expect that variation in prosocial *behavior* likewise has a partly genetic basis. Much of the existing research has implicated variations in the human receptor gene for the peptide hormone oxytocin. Oxytocin is generated by the hypothalamus and projected directly onto the striatum, amygdala, vagal motor and sensory nuclei, and other parts of the brain (Uvnäs-Moberg, Arn, & Magnusson, 2005). As with all hormones, oxytocin is chemically active only on cells containing a receptor, a molecular protein that enacts the hormone's instructions to affect cellular metabolism. In humans, the oxytocin receptor is encoded by the oxytocin receptor gene (*OXTR*).

Many genes, including *OXTR*, evidence single-nucleotide polymorphisms, or SNPs, which represent variations in the DNA sequence that occur when one of the four nucleotides—adenine (A), thymine (T), cytosine (C), or guanine (G)—differs between paired chromosomes (The International SNP Map Working Group, 2001). Each SNP represents variations in the form of the gene that are called *alleles*.

Multiple studies have found that genotypic variation in several *OXTR* SNPs is associated with various forms of prosocial communication, including compassion (Carter, Bartal, & Porges, 2017), affection (Floyd & Denes, 2015), and, most commonly, empathy (Wu, Li, & Su, 2012). In much of that work, groups of individuals evidencing different *genotypes*, or pairs of alleles, are compared to each other on their levels of empathy. For example, Rodrigues, Saslow, Garcia, John, and Keltner (2009) genotyped adults on the *OXTR* SNP rs53576, which comes in three genotypes: AA, AG, and GG. They found that individuals homozygous for the G allele—that is, who carried the GG pattern—evidenced higher empathic ability that did those with one or two copies of the A allele (either AA or AG). Skuse et al. (2014) similarly reported that autistic children homozygous for the A allele on rs53576 showed impairments in the ability to recognize previously seen faces. A recent meta-analysis by Gong et al. (2017) confirmed that rs53576 is associated with empathy for both European and Asian samples. Other *OXTR* SNPs also show associations with empathy, including rs2254298 (Montag et al., 2012) and rs13316193 (Wu et al., 2012).

These and similar studies focusing on individual SNPs have provided evidence that several *OXTR* SNPs have specific genotypes associated with greater prosocial communication. This discovery led Schneiderman, Kanat-Maymon, Ebstein, and Feldman (2014) to explore the association between empathy and genotypic variation using a "cumulative risk" approach. After genotyping five specific SNPs, Schneiderman et al. calculated a sum for each individual representing the number of SNPs (from 0 to 5) for which the individual had one of the "risk" genotypes (such as AA or AG on rs53576). This approach produced a continuous score, which Schneiderman and colleagues found to predict difficulties in empathic communication between partners in new romantic relationships. The greater the number of SNPs on which an individual carried alleles associated with lower empathy (i.e., "risk alleles"), the greater the difficulties that individual evidenced in empathic communication with a loved one.

It is one thing for variations in *OXTR* to predict a communicative quality such as empathy or compassion, but do they predict differences in actual affiliative *behavior*? Oxytocin itself shows reliable associations with social behavior in rodents (e.g., Insel & Shapiro, 1992; Ross & Young, 2009) and nonhuman primates (Winslow, Noble, Lyons, Sterk, & Insel, 2003), but studies of genotypic variation on *OXTR* and nonverbal affiliative behavior among humans are fewer.[1] Yrigollen et al. (2008) demonstrated that genotypic variation on *OXTR* relates to social behavior among children with autism spectrum disorders, and Feldman et al. (2012) showed that risk alleles on *OXTR* SNPs rs2254298 and rs1042778 predicted lower levels of touch between parents and infants (see also Bakermans-Kranenburg & van IJzendoorn, 2008).

Perhaps the most informative investigation to date regarding the association between nonverbal affiliative behavior and genotypic variation on *OXTR* is a study by Kogan et al. (2011). Kogan and colleagues selected 23 Caucasian adults who had taken part in an earlier study of dating couples (Impett et al., 2010). In that study, the adults had been genotyped on rs53576 (10 participants had the GG genotype, 10 had the AG genotype, and 3 had the AA genotype) and had completed a videotaped conversation with their romantic partner focused on an experience of personal suffering. The researchers subsequently coded the adults' behaviors for four nonverbal affiliative cues (head nodding, gaze, openness of arm posture, and smiling) and then combined those coded scores into a composite score representing the adults' affiliative behavior during the conversation. As expected, Kogan et al. found that adults with the GG genotype on rs53576 displayed more nonverbal affiliative behavior than did those who carried an A allele. Similarly, adults who were homozygous for the G allele were judged by third-party observers to be more prosocial than carriers of the A allele.

The Kogan et al. (2011) study was informative because it linked specific nonverbal affiliative behaviors to the risk allele (A) on rs53576. Two limitations of the study are significant, however. First, because the authors combined their coded scores for individual affiliative behaviors into a single composite score for analysis, it is impossible to know from their results how the genotype influenced individual nonverbal behaviors, and/or whether it affected some behaviors more strongly than others. Moreover, the study looked at only one SNP on the oxytocin receptor gene, and although rs53576 has been widely studied for its links to empathy and prosocial behavior, it is only one of several *OXTR* SNPs that show potential for accounting for variance in affiliation.

To be sure, no study would support the claim that all of the variation in social behavior has a genetic basis. Nonetheless, these research findings provide evidence for a statistically significant association between genotypic variation—at least on the *OXTR* gene—and nonverbal affiliative behavior. In the present study, we explore this association using the cumulative risk paradigm employed by Schneiderman et al. (2014), but using six *OXTR* SNPs rather than five for greater coverage. Like Kogan et al. (2011), we measured a cadre of nonverbal behaviors associated with affiliation, including smiling, facial expressiveness, immediacy, and facial pleasantness, as well

as dominance as an indicator of the lack of affiliation. Specifically, we predict that cumulative genetic risk on six SNPs—rs13316193, rs2254298, rs1042778, rs2268494, rs2268490, and rs53576—is directly related to frequency of smiling (H1), facial expressiveness (H2), immediacy (H3), and facial pleasantness (H4), and inversely related to level of dominance (H5).

We focused our attention in this study on students training to become PAs. A PA is a nationally certified and state-licensed health care provider who practices medicine on health care teams with physicians. PAs are trained in accredited master's-level programs and have prescriptive authority in all 50 U.S. states and the District of Columbia (American Academy of Physician Assistants, 2014). As of 2013, approximately 201,000 PAs were employed in clinical practice in the United States (Hooker, Brock, & Cook, 2016). PAs are a fruitful population to study because of their substantial role in primary care (Agency for Healthcare Research and Quality, 2010). According to figures released in 2010 by the U.S. Department of Health and Human Services Agency for Healthcare Research and Quality, 43.4% of practicing PAs worked in primary care (Agency for Healthcare Research and Quality, 2010). The previous decade also saw a 50% increase in the number of hospital outpatient visits overseen by a PA or nurse practitioner (NP) (Hing & Uddin, 2011).

Method

Participants

Participants were 38 students enrolled in the 1st year of a 2-year Master of Science degree in physician assistant studies at a graduate school of health sciences in the southwestern United States. There were 14 men and 24 women whose ages ranged from 21 to 45 years (M = 28.03 years, SD = 5.60). The majority (84.2%) identified as Caucasian, whereas 15.8% were Asian/Pacific Islander, 5.3% were Native American/Alaskan, and 5.3% claimed other ethnic backgrounds (these percentages sum to >100 because participants could claim more than one ethnicity). At the time of the study, all students had completed a baccalaureate degree, and five had also completed a master's degree in another field.

Procedure

Students were recruited from among the entire 1st-year PA student class, via an e-mail announcement from the PA department chair and a verbal presentation to the class from the first author. Out of 50 students in total, 38 volunteered to take part in the study (a response rate of 76%).

On three subsequent occasions over a 6-month period, students conducted an objective structured clinical examination (OSCE) with professional standardized patients (SPs). SPs are laypeople trained to portray common clinical complaints in a simulated medical environment (van Zanten, Boulet, & McKinley, 2007). In all, 13 SPs worked with the research team on this study. The SPs had an average of 3.38 years of

work experience as standardized patients. All were trained by the third author to accurately role-play case details and to rate PA students' empathy. The third author has worked professionally as a standardized patient educator and medical education assessment consultant since 2007. Seven SPs were used for each round of clinical interviews. SPs received approximately 4 hours of training before each round of interviews and were paid for their time spent in training and in interviews.

PA students were randomly assigned to SPs during each round of clinical interviews. During each round, each PA student saw only one SP, but each SP saw several students. There were no significant differences in any of the PA students' nonverbal affiliative behaviors that were attributable to which SP the students saw in a given clinical encounter.

For each round of interviews, SPs were trained to present with symptoms indicative of a specific pathology. During the first round, SPs were trained to portray symptoms consistent with hypertension. In the second round, they depicted a neurological disorder/headache, and in the third round, symptoms consistent with chronic obstructive pulmonary disorder (COPD). These conditions were selected because they are common presenting complaints in primary care and because they corresponded to the pathologies that students were studying at the time of each round. In each case, a complete cover story about the SPs' personal and professional life, medical history, habits, and symptoms was constructed and used in training.

The clinical interviews took place at the health sciences university in rooms equipped with medical examination tables and video-recording devices. In each interview, the PA student greeted his or her assigned SP and asked questions about symptoms and lifestyle intended to lead to a differential diagnosis. During the second and third round of interviews, he or she also conducted a physical examination. Each interview was audio- and videotaped. Immediately following each clinical interview, trained raters coded the amount of smiling, dominance, facial expressiveness, immediacy, and facial pleasantness displayed by PA students during the interview.

During the first round of interviews, students also provided saliva samples for genotyping. Approximately 4 mL of saliva was collected from each student into marked plastic cryovials via stimulated passive drool. Samples were immediately frozen before being shipped on dry ice to a professional service laboratory for genetic analysis. The entire study was approved by the university's bioscience institutional review board. Some aspects of the method are also reported in Floyd, Generous, Clark, Simon, and McLeod (2015) and in Floyd, Generous, Clark, McLeod, and Simon (2017).

Coding of Nonverbal Behavior

Four trained coders, working in pairs, coded the students' nonverbal behaviors in each clinical examination from the videotapes. Coded behaviors were smiling, dominance, facial expressiveness, immediacy, and facial pleasantness. All behaviors were coded on 1–7 scales. Smiling represented the frequency of smiles enacted

during a clinical examination. Dominance represented coders' agreement with the perception that students "tried to dominate the conversation." Facial expressiveness represented coders' perceptions that students' faces were expressive and communicative. Immediacy represented coders' perceptions that students signaled interest in and engagement with patients, especially through their facial behaviors. Finally, facial pleasantness represented the perception that students' facial expressions had a positive valence.

Coders were advanced undergraduate communication majors who had completed coursework in nonverbal communication and who received independent study credit in exchange for their work. They received approximately 10 hours of individual and collective training, which comprised reviewing the definitions of each behavior and conducting practice coding from the videotapes. All coders were blind to the hypotheses. Intercoder reliabilities, based on Ebel's intraclass correlation (Guilford, 1954), appear in Table 1.

Genetic Measures

Six single-nucleotide polymorphisms on the oxytocin receptor gene were genotyped for each student. The six *OXTR* SNPs were: rs13316193, rs2254298, rs1042778, rs2268494, rs2268490, and rs53576. Genotyping was performed from DNA extracted from students' saliva samples by Salimetrics LLC, a professional service laboratory, in accordance with procedures described by Schneiderman et al. (2014). A modified PureLink Genomic extraction method was used to isolate DNA from passive drool. TaqMan SNP Genotyping Assays (Applied Biosystems/LifeTech) were then used to amplify and detect alleles for *OXTR* SNPs. For each SNP analysis, polymerase chain reaction (PCR) amplification was performed by an Applied Biosystems 7500 Real-Time PCR machine using sequence-specific DNA primers and TaqMan PCR universal mastermix. DNA was successfully extracted from 100% (38 of 38) of the saliva samples. For all six SNPs, 100% of the DNA samples were successfully genotyped.

OXTR cumulative risk scores were calculated by assigning for each SNP a value of 1 to the risk allele (identified by previous research as being least associated with prosocial behavioral tendencies) and a value of 0 to all other alleles, and then summing the scores for all six SNPs. The risk allele associated with each SNP is

Table 1 Reliabilities for Coded Variables

Variable	T1	T2	T3	*M*
Smiling	.96	.75	.71	.81
Facial expressiveness	.99	.88	.88	.92
Immediacy	.92	.86	.85	.88
Facial pleasantness	.85	.76	.74	.78
Dominance	.68	.94	.96	.86

Note. Reliability estimates are based on Ebel's intraclass correlation.

Table 2 Genotypic Distributions for Six Single-Nucleotide Polymorphisms on the Oxytocin Receptor Gene

SNP	Risk Allele (*n*)	Allele Form Two (*n*)	Allele Form Three (*n*)
rs53576	AA (6)	AG (16)	GG (14)
rs1042778	TT (4)	GT (16)	GG (18)
rs2268494	AA (36)	AT (2)	—
rs13316193	TT (6)	CT (20)	CC (12)
rs2254298	GG (24)	AA (14)	—
rs2268490	TT (1)	CT (13)	CC (24)

Note. SNPs rs2254298 and rs2268494 exhibited two genotypes only. This table also appears in Floyd et al. (2017).

identified in Table 2. For each student, this resulted in a cumulative risk score with a theoretic range of 0 to 6. Observed scores ranged from 0 to 3, with an average score of .88 (SD = 1.00). Descriptive statistics and intercorrelations with other study variables appear in Table 3.

Distributions for all genotypes, including risk alleles, appear in Table 2. All six distributions were in Hardy-Weinberg equilibrium, indicating that the frequencies of these genotypes are likely to remain constant from one generation to the next in the absence of disturbing factors such as genetic drift, mutations, or nonrandom mating (e.g., Moonesinghe et al., 2010).

Results

To identify potential control variables for the hypothesis tests, we tested the PA students' sex, age, and ethnicity for effects on nonverbal affiliative behaviors. Sex of student affected only facial expressiveness, t (37) = −2.60, p (two-tailed) = .01, Cohen's d = .85, with women (M = 3.58, SD = 0.57) exceeding men (M = 3.02, SD = 0.74). All

Table 3 Means, Standard Deviations, and Intercorrelations for Study Variables (N = 38)

Variable	*M/SD*	1	2	3	4	5
1. Cumulative genetic risk	0.88/1.00	—				
2. Smiling	1.73/0.45	−.37*	—			
3. Dominance	4.43/0.21	.30*	−.28*	—		
4. Facial expressiveness	3.37/0.68	−.39**	.74**	−.11	—	
5. Immediacy	3.60/0.52	−.31*	.77**	−.14	.79**	—
6. Facial pleasantness	4.53/0.73	−.19	.50**	−.01	.50**	.88*

Note. All variables except cumulative genetic risk were measured on 7-point scales wherein higher scores indicate a higher level of the variable.
*p < .05. **p < .01 (one-tailed).

other sex comparisons were nonsignificant. None of the behaviors varied as a function of students' ages or ethnic backgrounds.

The hypotheses proposed that PA students' cumulative risk score on the *OXTR* receptor gene predicted their frequency of smiling and level of facial expressiveness, immediacy, facial pleasantness, and dominance during clinical examinations with standardized patients. We used zero-order correlations and hierarchical regressions to test the hypotheses. To mitigate alpha inflation, given that we had three assessments each of students' nonverbal affiliative behaviors (at time 1, time 2, and time 3), we calculated criterion variables by aggregating the coded scores for each behavior across the three time periods.

Associations between genetic risk and smiling, dominance, immediacy, and facial pleasantness were tested with zero-order correlations, given that none of the potential control variables tested produced a significant effect. As Table 3 reports, genetic risk was inversely related to smiling ($r = -.37$) and immediacy ($r = -.31$) and directly related to dominance ($r = .30$), in support of H1, H3, and H5. That is, the more risk alleles a PA student possessed (among the six measured), the more dominant and less immediate the student was, and the less often he or she smiled during the clinical encounters. Contrary to H4, genetic risk was not significantly related to facial pleasantness (−.19), although the correlation coefficient was in the hypothesized direction.

The association between genetic risk and facial expressiveness was tested in a hierarchical regression, with participant sex (dummy coded as 0 = male, 1 = female) entered in the first block and genetic risk entered in the second block. With the effect of sex controlled, genetic risk produced a significant inverse association with facial expressiveness, b = −.34, $p = .025$. In other words, the more risk alleles a PA student possessed, the less facially expressive he or she was during the clinical encounters. Complete regression results appear in Table 4. H2 is supported.

For further exploratory purposes, we also analyzed PA students' nonverbal immediacy behaviors by comparing mean differences between groups with each genotype on each SNP. For rs53576, for instance, we conducted one-way ANOVAs with genotype as the independent variable and the coded nonverbal behaviors as the dependent variables. (For rs2254298 and rs2268494, we used independent-samples *t*-tests in place of

Table 4 Multiple Regression Predicting Facial Expressiveness from Cumulative Genetic Risk ($N = 38$)

Models and Variables	B	*SE* B	β	ΔR^2
1. Sex	0.56	0.21	.40*	—
2. Sex	0.48	0.20	.36*	0.12
Cumulative genetic risk	−0.23	0.10	−.34*	

Note. Zero-order correlations appear in Table 2.
*$p < .05$. $R^2 = .27$, adjusted $R^2 = .33$, F (2, 35) = 6.52, $p < .01$.

ANOVAs, given that each SNP had only two genotypes.) Out of all possible mean comparisons, only two were significant. For rs2254298, students with the AA allele smiled more ($M = 1.93$, $SD = 0.45$, $n = 14$) than did those with the GG allele ($M = 1.62$, $SD = 0.42$, $n = 24$), $t\ (36) = 2.15$, $p = .038$, Cohen's $d = .71$. For rs2268494, students with the AA allele had more facial expressiveness ($M = 3.43$, $SD = 0.63$, $n = 36$) than did those with the AT allele ($M = 2.31$, $SD = 0.97$, $n = 2$), $t\ (36) = 2.39$, $p = .002$, Cohen's $d = 1.37$. The failure of all other mean comparisons to achieve significance suggests the superiority of the cumulative risk approach over analysis of individual SNPs.

Discussion

This study examined nonverbal affiliative behavior directed toward patients by students training to become physician assistants. Affiliative communication is associated with multiple outcomes in the relationship between physicians and patients (Hojat et al., 2011; Kim et al., 2004; Mast et al., 2008), so as PAs assume a continually greater role in primary care, it is worth investigating their affiliative communication abilities as well. Moreover, whereas the consequences of affiliative behavior—such as for patient satisfaction, compliance, and health—are well documented, the antecedents of affiliative communication ability have been less extensively adjudicated.

Drawing on previous research linking other forms of prosocial communication (compassion, affection, empathy) to variations in specific single-nucleotide polymorphisms on the oxytocin receptor gene (Kogan et al., 2011; Schneiderman et al., 2014), we investigated the extent to which variance in nonverbal affiliative communication behaviors is accounted for genetically. Despite the tendency to think of prosocial communication ability as wholly acquired (through training, socialization, enculturation, etc.), we identified significant proportions of the variance—at least, in four out of five nonverbal affiliative behaviors—that are accounted for by the students' genotypes. Moreover, the effect sizes were moderate (r^2 values ranged from .09 to .14), suggesting that the genetic effects are not trivial. This finding certainly does not suggest that the influences of training, socialization, and other environmental factors on affiliative behavior are negligible. It does suggest, however, that affiliative behavioral tendencies may, to some extent, be innate, meaning that there are perhaps ceiling effects in the efficacy of training and instruction for prosocial communication.

Adopting a cumulative risk approach to examining genotypic variation was useful, insofar as it represents a continuous approach to indexing the genetic signatures previously associated with prosocial behavior, making patterns of covariation easier to identify. Indeed, had we tested our hypotheses simply by comparing the various empathy assessments for each SNP individually (via a *t*-test or one-way ANOVA, as is often done; e.g., Floyd & Denes, 2015), instead of adopting a collective, continuous approach, we would have failed to identify most of these patterns, as the individual discrete comparisons were almost always nonsignificant. For rs2254298, the GG allele is the risk allele, so the finding that participants with the AA allele smiled more than those with the GG allele is consistent with the study's

predictions. For rs2268494, the risk allele is AA, so the finding that participants with the AA allele had more facial expressiveness than those with the AT allele is inconsistent with the study's predictions, although it should be noted that only 2 participants carried the AT allele on rs2268494, so this mean comparison must be interpreted cautiously.

Like all studies, this one enjoyed certain advantages and suffered certain limitations. Conducting our clinical interviews as an integral part of the PA students' training—rather than as a side activity—bolstered the external validity of our approach. The use of standardized patients, although perhaps a detriment to external validity, increased the internal validity of the study by maximizing consistency in the stimuli to which the students were asked to attend.

The inclusion of genotypic assessment as an independent variable allowed for identification of some portions of the variance in students' nonverbal affiliative behavior that are innate rather than acquired. Again, this is not to diminish the force of environmental contributions to prosocial communication, but rather, to understand their scope more precisely. Perhaps most important, this study documented associations between actual nonverbal affiliative behaviors instead of simply *qualities* of social behavior, such as compassion, empathy, and affection.

Relatedly, we would not claim that the six SNPs included in this exploratory study would account for all genetic variation in affiliative behavior. The SNPs in the present study were selected based on empirical evidence of their influence on related prosocial abilities (such as empathy and compassion), but one limitation of the study is that many other potential sources of genetic influence were unexamined and await investigation. Based on previous research, possibilities for future studies include the serotonin transporter (5-HTT) gene (Bakermans-Kranenburg & van IJzendoorn, 2008) and the serotonin 5-HT_{2A} receptor gene (Kusumi et al., 2002).

A second limitation was that, due to the context of a mock clinical examination, some nonverbal behaviors that might normally be considered affiliative were difficult either to code precisely or to interpret. For instance, coding gaze was difficult because of the relative placement of the examination rooms' cameras to the examination tables, and because PA students were moving and changing position in the service of the clinical interview and physical examination. Similarly, although touch might normally be considered affiliative, virtually all touch enacted between PA students and standardized patients—outside of introductory handshakes—was instrumental touch performed during the physical examination. Thus, in this context, we would not consider such touch to have affiliative connotations, the way that touch recorded between romantic partners in the Kogan et al. (2011) study would.

Perhaps the most significant limitation was the sample size of 38 students, all from the same PA training program. Although significant hypothesized findings emerged, the small sample attenuates external validity and raises legitimate questions about whether the findings would replicate with other samples, particularly those drawn from different populations of PA students (those in other training programs or from other regions). More than any other limitation, this should encourage

readers to exercise caution in the interpretation of these results and to consider the findings tentative until independently replicated.

Similarly, only three specific pathologies (out of many that a practicing PA would encounter) were presented in the clinical examinations. It is certainly possible that the type and severity of the presenting complaint could influence the level of nonverbal affiliative behavior that a PA (or PA student) would display, and this would be a useful comparison for future research to draw.

Besides determining the extent to which these patterns replicate, an important next step in this research could be to implement pedagogical approaches for increasing nonverbal affiliative behavior among medical or PA students and then to determine whether they are more effective for students with some genotypes than others. According to existing research, a healthcare provider's ability to convey affiliation is associated with numerous benefits for patients, and perhaps also for the providers themselves. Developing training units aimed at teaching and rehearsing empathic communication skills—and then testing their efficacy experimentally—would be a beneficial extension of this research.

Disclosure statement

No potential conflict of interest was reported by the authors.

Note

1. It should be acknowledged, however, that many other aspects of human social experience, including loneliness (Lucht et al., 2009), stress reactivity (Rodrigues et al., 2009), support seeking (Kim et al., 2010), emotionality (Montag, Fiebach, Kirsch, & Reuter, 2011), trust (Krueger et al., 2012), and pair bonding (Walum et al., 2012), have been studied in relation to genotypic variation on *OXTR*.

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