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Conformity of behaviors among medical students: impact on performance of knee arthrocentesis in simulation

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Abstract Although the development of collaborative relationships is considered a requirement for medical education, the functioning of these relationships may be impaired by a well-documented social-psychological phenomenon known as group conformity. The authors hypothesized that students would insert a needle into an incorrect location relative to the patella when performing a knee arthrocentesis if they believed that their peers had also inserted a needle in the same incorrect location. This was a randomized controlled study conducted in 2011 with 60 medical students (24 male; 40.0 %) who were randomly assigned to either using a knee model that had a skin with holes left by peers inserting needles in the wrong location, or a knee with no marks in the skin. Each student's aspiration site was measured with a fibreglass ruler to determine whether it was correctly located within the superior third, 1 cm medial to the patella. The researchers determined that students who used the marked skin were more likely to insert the needle in the incorrect location compared to those who used the clean skin ($n = 31$, 86.11 vs. $n = 14$, 58.33 %), Fisher's exact test (1) = 5.93, $p < 0.05$, Cramer's $\phi = 0.31$. This study demonstrates incorrect performance of the knee arthrocentesis procedure in simulation when students use a damaged model, which may be due to conformity. It suggests that further research on the impact of conformity in medical education is warranted.

Keywords Conformity to the majority · Medical students · Simulation · Undergraduate medical education

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Introduction

Collaborative, transdisciplinary, and team-based models of patient care have been widely embraced as critical to medical education (Canadian Medical Association 2007; Harden et al. 1999; Hodges and Kuper 2012). Rather than a method of care, Martin (2011) argues that it is a state of being, whereby educational and professional experiences form a physician's sense of relational identity. Such an internalized and personalized view generally conjures images of ethical, respectful, and valued relationships. This impression, we argue, is idealistic. Rather, there are subtle and obscured behaviours, feelings, and motivations that operate within groups, which have been studied over the last 70 years by social psychologists. One such group dynamic is known as group conformity. In this study, we present empirical evidence of how conformity among final year medical students has an impact on their performance while learning a clinical procedure.

In a series of seminal studies, social psychologist Solomon Asch (1952, 1955, 1956) examined the effect of group membership on the behaviour of an individual member of the group. When each member provided the same incorrect response to a line matching perception test, the individual who was uninformed about the purpose of the study was more likely to provide the same incorrect response than when group members provided correct responses. These studies demonstrated that when an individual encounters information from the group that is contrary to his own understanding, he is likely to revise his response to match that of the group's. This conformity occurs, moreover, in response to incorrect information provided by the other members of the group. Asch concluded that there are two forces within the group environment: the need of each individual to belong, and the need for organization within the group. The individual's need to gain group membership may include a desire for friendship, trust, and admiration (Asch 1955). This need of every group member initiates the process of group equilibrium, whereby each person acts in accordance to the group structure. In this way, people psychologically organize themselves within groups. In other words, "In society, each becomes dependent upon others for the most basic things … this is a necessary condition for durable human relations" (Asch 1955). Thus, when there is a conflict between the group's and the individual's perception, individual conformity to the group is likely to occur. Applied to higher education, the individual may encounter a conflict between the personal aspiration to express one's own idea, and the desire to establish potentially long-term networking relationships among new colleagues. This latter need is likely to motivate the individual to provide responses that are consistent with the majority of responses in the group, even when they are incorrect.

This conformity effect has been shown under various conditions to be a universal aspect of human interaction. People who fear a negative evaluation are particularly likely to show conformity (Wright et al. 2010). Also, in addition to judgments about perception tasks, people are likely to alter their preferences (Guo et al. 2010). It is not known whether they show behaviorial changes, however. The extent to which the majority can have an impact on student learning of a course curriculum is also not understood. These queries are directly pertinent to how medical students learn clinical skills when in a group setting. Despite 50 years of replication studies (Berry 1967; Boldt 1976; Doms and van Avermaet 1981; Mori and Arai 2010; Neto 1955), conformity has not been studied in the context of medical education.

This study will provide behavioural evidence of how clinical skill development may be influenced by peers. Specifically, the aim is to determine whether medical students' performance on a clinical task is influenced by the perceived previous performance of their peers. We hypothesized that medical students would more likely attempt aspiration at a

location (which was incorrect) when performing a knee arthrocentesis if they believed that their peers had also attempted aspiration in the same incorrect location, than if they believed their peers had not. Although researchers have conjectured on the possible influence of conformity (Henriksen and Dayton 2006), empirical evidence is necessary to justify curriculum planning that ensures learners are aware of and prepared to manage this in their group learning activities. Group conformity may, moreover, have implications for all physicians at any stage of their career during conversations with colleagues on diagnosis and treatment.

Methods

All final-year (3rd year) medical students who attended the 2 h knee arthrocentesis simulation session between April and July 2011 were invited to participate in the study. At the University of Calgary we have a three year Clinical Presentation Curriculum, during which the first 2 years are pre-clerkship, and the final year is the clinical clerkship. All participating students were clinical clerks during the time of this study. Students attended these sessions in groups (3–6 medical students each, 14 groups in total). Groups were randomly assigned to (1) the control condition with a model that had no visible holes in the skin, or (2) the experimental condition whereby puncture marks (holes) were shown in the wrong insertion position (inferior to the midline of the patella). All students in the control condition used the same unmarked knee as did all the students in the experimental condition who used the same marked knee.

During the session, each student viewed an instructional video on the knee arthrocentesis (Thomsen et al. 2006), followed by a 15 min discussion on the procedure facilitated by the preceptor. Then a researcher escorted one student to the adjoining simulation room, while the remaining group members learned a different bedside procedure (shoulder arthrocentesis). The adjoining simulation room consisted of a knee arthrocentesis simulator (Limbs and Things®, see Fig. 1) and a procedural tray. All participants completed a survey on their baseline procedural experience by recording the number of times they had observed and conducted the knee arthrocentesis procedure in simulation and in clinical settings. Then they were instructed to perform the procedure as they would in a pre-test similar to an objective structured clinical examination (OSCE) format, in accordance to the instructions as outlined in the instructional video (Thomsen et al. 2006). They were also told to conduct the procedure on the medial aspect of the simulator, but to leave the needle in the model after making only one attempt, irrespective of whether they were able to aspirate fluid. They were also told to disregard any markings they may see on the model used to teach students the knee procedure. Their final instruction was to verbalize all the steps as they executed them. The researcher provided no feedback and merely observed each student. Once the student completed the procedure and returned to the group, the researcher measured the needle's position with a fiberglass tape measure and prepared the simulator for the next student. After each student participated in the simulation, the group entered the simulation room, and the preceptor reviewed and allowed the learners to practice the procedure with guided feedback until everyone completed the procedure successfully.

All students were then debriefed about the purpose and design of the study. They were told that this information will determine whether conformity to peers affects performance of a procedural skill. Once all questions were answered, the researcher left the room while they read the consent form. All students gave signed consent for their data to be analyzed,

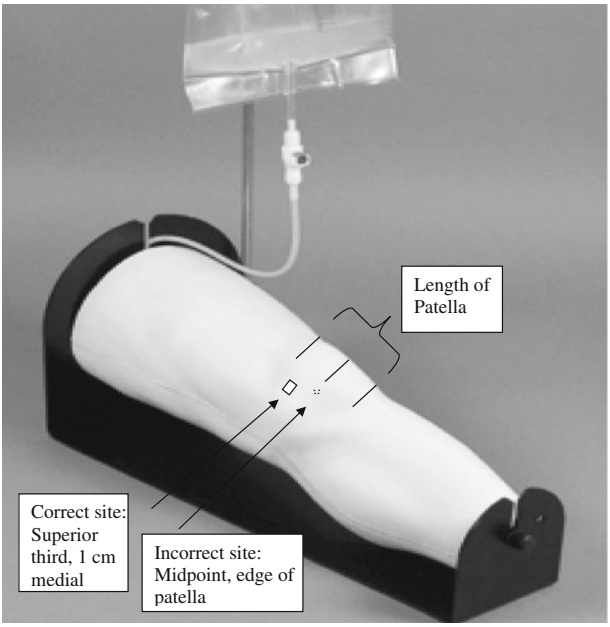

Fig. 1 Picture taken from Limbs and Things®, with location of patella, correct aspiration site, and incorrect aspiration site shown

and no students expressed concern about being informed at the end, rather than at the beginning, of the study. The study followed the debriefing guidelines for behavioral research of the American Psychological Association and was approved by the University of Calgary Health Research Ethics Board. After completion of the training session, students in the experimental condition were asked by the PI to remain to participate in an exit interview.

A total of three researchers collected data, and six preceptors taught the sessions, which were standardized with the use of the video. All discussion of the procedure pertained to information provided in the video. Site of needle insertion did not significantly differ across researchers or preceptors according to Chi square analyses, $p > 0.05$.

Measures

The location of the needle was measured in two directions: the length was measured to the distal aspect of the knee model, and the width was measured to the medial seam of the skin (Fig. 1). The distal aspect of the simulator and the medial seam were chosen as reference points as they provide reliable estimates of the needle location, according to inter-rater reliability between two raters on practice attempts of 10 different locations (Intraclass correlation coefficient = 0.85). As shown in Fig. 1, the correct insertion site was independently judged by two preceptors, who organized the teaching session, to be within 4–6 cm from the seam, and 20–23 cm from the distal aspect of the simulator. These dimensions are consistent with the instruction in the video (Thomsen et al. 2006), which recommended the superior third of and 1 cm medial to the patella. All sites outside of this area were coded as incorrect. For the simulator in the experimental condition, multiple puncture marks were placed at 19 cm from the distal aspect of the simulator and 7 cm from

the seam (i.e. more inferior and medial than the recommended location). Two faculty members independently confirmed that this was the incorrect location for the aspiration. Also, it was noted that all students verbalized the correct insertion site for the needle as the superior third of the patella before they inserted the needle.

In the exit interviews, students were asked three questions about their experiences using the knee model: "Did you notice any marks on the model?", "Why do you think they were there?", and "Did the marks affect you in any way?" One researcher facilitated the discussion and the other wrote down the students' comments. Consistent with grounded theory methodology (Glaser and Strauss 1967), each statement was labelled with tentative themes then statements with the same or similar themes were grouped together. Two of the authors independently reviewed both the themes and the statements, and then discussed them until consensus of the major themes was reached.

Results

A total of 60 medical students ($n = 24$ male; 40.0 %) participated. This number represents 65.22 % of the total number of students available to attend the course ($n = 92$). There was no significant difference between the number of male and female students in each condition, χ^2 (1) = 0.05, $p > 0.05$. The number of times students reported observing or conducting the knee arthrocentesis procedure in simulation ($M = 0.33$, SD = 0.48, $M = 0.02$, SD = 0.13, respectively) and in clinical settings ($M = 0.55$, SD = 1.02, $M = 0.10$, SD = 0.35, respectively) was low. Thus, students had minimal previous exposure to the knee arthrocentesis procedure, and a multivariate analysis of variance determined that it did not differ between conditions, Wilks' $\lambda = 0.97$, $F(4, 55) = 0.42$, $p > 0.05$. In addition, we examined whether students who inserted the needle in the correct location had a shorter duration of wait time between seeing the instructional video and attempting the procedure. A univariate analysis of variance indicated that order of procedure did not differ between those who aspirated in the correct site and those who did not, $F(1,58) = 0.21$, $p > 0.05$.

As shown in Table 1, there was a significant difference in aspiration site between the two conditions, Fisher's exact test (1) = 5.93, $p < 0.05$. A higher proportion of students in the control condition (no visible holes in the skin) attempted aspiration in the correct position compared to the experimental condition (puncture marks in the incorrect location). Similarly, a higher proportion of students in the experimental condition, compared to the control condition, inserted the needle in the incorrect location. The size of this difference is in the medium range (Cramér 1999), Cramer's $\phi = 0.31$, and produces a relative risk ratio of 1.48 [1.02, 2.12], $p < 0.05$. There was no significant difference in correct aspiration site between male and female students, $p > 0.05$.

During the exit interviews, all students in the experimental condition ($n = 36$) responded affirmatively to the question about noticing marks on the model and, in response to the second question, believed they had been made by previous students performing the knee arthrocentesis procedure. When asked how they were impacted by the marks, three themes emerged. First, several students ($n = 15$, 41.67 %) stated they aspirated in the marks due to uncertainty: "The marks were like a magnet, they pulled me down because I wasn't sure." Second, some students ($n = 9$, 25.00 %) indicated that following other students is customary: "We're used to marks on models, especially the lumbar puncture. There's a big hole with little holes around it and that's where everyone puts the needle." Third, others ($n = 5$, 13.89 %) stated that they considered aspirating in the holes but

Table 1 Number (proportion) of students aspirating in each site by condition

	Condition	
	Experimental	Control
Location		
Correct	5 (13.89 %)	10 (41.67 %)
Incorrect	31 (86.11 %)	14 (58.33 %)
Total	36	24

re-considered: "The marks on the knee made me re-think, but then I ignored them." Others stated they were not at all influenced by the marks ($n = 7$, 19.44 %).

Discussion

This study provides behavioral evidence of students incorrectly performing a clinical procedure when using a model that was damaged to give the appearance of peers' incorrect performance. Moreover, students selected the incorrect location for the aspiration despite simultaneously verbalizing the correct location. Our study clearly necessitates the use of undamaged materials in simulation. Marks seem to serve as a cue to students as to how to perform a procedure, which does not represent how physicians will encounter real patients. Indeed, one preceptor wittingly commented to a student that she would need someone making holes in her patients for her to follow if that is how she determines where to insert a needle!

Returning to Martin's call for the development of a professional identity in relation to colleagues and patients (Martin 2011), we speculate that conformity may be implicitly inherent to these relationships and motivated by human emotional needs for acceptance and belonging. While these needs are not perilous, they may influence clinical behavior–as seen in clerks' performance with the knee simulation. The incidence of hospital medical errors is approximately 9 %, with miscommunication as one of its causes (Bartlett et al. 2008; de Vries et al. 2008). Information may be mismanaged in a group situation where there is a strong need to "be a team player", "collaborator" and where these terms are interpreted to mean one who agrees and "goes along" with group consensus. Indeed, "… [due to] a desire to maintain harmonious working relationships with colleagues, providers suppress their concerns about doing the right thing, and further distance themselves from having meaningful discussions about practices that will ensure safe and high quality care" (Henriksen and Dayton 2006). Medical education reform must directly confront these tendencies and build into the curriculum strategies for communicating assertively and respectfully when encountering inaccurate or conflicting information. Pian-Smith and colleagues (Pian-Smith et al. 2009), for example, have begun teaching students methods of inquiring and challenging when they perceive inaccurate or contradictory information. This type of awareness and discourse is grounded in the need to improve patient safety.

Exit interview results and researchers' observations revealed several insights. First, although uncertainty about the correct location may have motivated some students to conform, this was not necessary for conformity. Second, following their peers had become customary for some students. Perhaps they had begun to rely on each other for guidance when learning new information. Having been assigned to groups since the beginning of

their program, this form of group "support" may have become an adaptive strategy for managing the curricular demands. Third, not all students follow their peers.

There are two alternative explanations for the results of our study. First, students in the experimental, compared to the control, condition were exposed to more information as a result of the marks on the knee. This extraneous information may have distracted them, thereby reducing their performance. This information may have also created a base rate fallacy, postulated by Tversky and Kahneman (1974), whereby the marks on the knee may have provided a low reference point from which to estimate. Comments from the students (e.g. *I said the right place, but then I inserted the needle in one of the holes because I thought students were going there; I thought the holes were in the right place because other students had poked there*.) do not lead to these explanations; nevertheless, they should be explored in future research. Second, students may have believed that the marks were in the superior third of the patella, and, thus, inserted the needle where they believed the correct location to be. We do not consider this to be a strong explanation as the video clearly showed a picture of a needle entering the superior third of the knee, which closely matched the appearance of the knee model. Moreover, session instructors who were unaware of the purpose of the study, had noted that needle marks on the simulator were in the wrong location, at the midpoint of the knee. All students palpated the knee to determine the location of the patella and would have been able to estimate the superior third. In addition to alternative explanations, caution must be taken when interpreting the reason for conformity. We have inferred that conformity is driven by the need for belonging to the peer group, but it is possible that students do not want to stand out as different from their peers, or perhaps that they are compliant to the behaviour of the majority. For example, Kennedy et al. (2009) found that residents were reluctant to seek help with patient care for fear of appearing incompetent and unable to practice independently. These internal motivations are difficult to ascertain as they are not observable and self-report methods of these internal drives may not be accurate.

There are limitations to the present study. First, it was conducted at a single site with only those students who did not have a scheduling conflict and were available to attend the teaching session. Although the proportion of men and women who attended represents the population of students at the University of Calgary, it is unknown if other characteristics of the students systematically differed between those who did and did not attend. Second, measuring a three dimensional surface with a ruler may have resulted in imprecise measurements; however, the reliability was good. Third, over the duration of the study participants may have informed other students about the study, which could have impacted the later participants' performance. All students, however, were asked if they were aware of the study, and only one student had. This person's data were excluded.

This is the first study to suggest the possibility of conformity in medical education. Replication with students in various years, different tasks, and other settings within their program are called for given this preliminary evidence. Of course, this study does not suggest that medical students will carry out procedures such as the knee arthrocentesis incorrectly once in practice as a result of conformity to their peers, but it does suggest that this possibility must be examined in future research.

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Conflict of interest None.

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