Working Paper:

Social Influences on Human Capital Investment: Evidence from a Continuing Education Program in the US Army

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Human capital investment represents a complex and far-reaching individual decision that may be influenced by the educational choices made by others, yet we know far less about peer effects at this extensive margin than we do at the intensive margin of education production itself. In this paper, I rely on a unique source of exogenous variation in which individuals randomly receive exposure to different levels of peer investment in human capital and then make their own education participation decisions. Specifically, I study new US Army soldiers who are randomly assigned to companies that vary substantially in their existing participation rates in a subsidized continuing education program. I find that a new soldier assigned to a high-participation company is far more likely to take classes than a soldier assigned to a low-participation company. Building on prior work examining neighborhood and peer effects, I decompose this overall impact into neighborhood, leadership, and peer influences. The decomposition suggests that differences across Army locations and other common shocks are largely responsible for the impacts I observe, though I also find a modest peer effect on participation.

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SOCIAL INFLUENCES ON HUMAN CAPITAL INVESTMENT: EVIDENCE FROM A CONTINUING EDUCATION PROGRAM IN THE US ARMY

Francis X. Murphy

Introduction

For at least 50 years, social scientists have wrestled with the question of how environments and peers influence individual decision making and outcomes in education, health, and other important policy domains. The well-known Coleman Report (1966) notes the correlation between a pupil's achievement and the educational backgrounds and aspirations of the other students in the school. Recent work by Raj Chetty and co-authors (2016) shows significant geographic variation in lifetime health outcomes across income groups. For example, low-income males living in Detroit have life expectancy that is 5 to 6 years lower than low-income males in New York or San Francisco. While researchers suspect that environmental and peer differences may contribute to these geographic disparities, there is still much to learn about how external influences affect individual decision-making and outcomes.

Estimating the causal impact of neighborhood and peer influences is inherently challenging given that individuals typically select the environments in which they live and the peers with whom they associate. For instance, a family that prioritizes high-quality primary education might choose to live in a neighborhood that features highly regarded and well-resourced elementary schools. Such neighborhoods may also have additional resources (e.g. better-funded libraries) that support educational pursuits and neighbors who similarly value and promote education. Although we are interested in individual student outcomes that may be influenced by these inputs, selection problems make it difficult to isolate the causal impact of those environmental and peer influences.

Despite these selection challenges, many authors have examined the influence of environments and peers in education and other outcomes. Case and Katz (1991) find strong neighborhood influence on outcomes such as crime involvement, drug and alcohol use, and church attendance. A series of papers analyzes the Moving to Opportunity (MTO) project, in which residents of housing projects were randomly assigned vouchers they could use to purchase housing in other communities. The early MTO papers[1] find that moving to a lower-poverty neighborhood results in better short-run outcomes for young females and improved health outcomes for adults,

[1] See Kling, Ludwig, and Katz (2005), Kling, Liebman, and Katz (2007), and Sanbonmatsu et al. (2006).

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but that there are no detectable effects on child math and reading achievement. A new MTO paper by Chetty, Hendren, and Katz (2016), however, finds that children who moved to a low poverty neighborhood at a young age are far more likely to attend college.

Many studies in the last two decades have estimated peer effects in education. Several authors have found evidence of peer effects on the intensive margin of education; these studies typically rely on randomness generated within the process of organizing for school (like assignment to a classroom in primary school or to a roommate in college). Hoxby (2000), Duflo, Dupas, and Kremer (2011), and Imberman, Kugler, and Sacerdote (2012) find that stronger peers have a positive effect on individual performance in primary school. The effects often vary across the ability distribution, with students at either tail benefitting more greatly from better peers. Sacerdote (2001), Kremer and Lavy (2008), and Carrell, Fullerton, and West (2009) study social interaction in college and find relatively larger impacts from peers on non-academic outcomes, such as the decision to join a fraternity or sorority, as well as modest evidence of nonlinear peer effects on academic outcomes.

A small recent literature addresses peer influences in education investment decisions, like going to college. Bifulco, Fletcher, and Ross (2011) relies on within-school, across-cohort variation in high school classmate characteristics and finds that an increase in the percent of peers with college-educated mothers increases own likelihood of college-going. In a field experiment examining peer *pressure*, Bursztyn and Jensen (2015) finds that high school students are less likely to sign up for a free SAT preparatory class if told that their signup decision will be made public.

In this paper, I rely on a unique source of exogenous variation in human capital investment in which new US Army soldiers are randomly assigned to companies that vary substantially in their participation rates in a subsidized continuing education (CE) program. The Army is like many large corporations that subsidize continuing education programs for their employees (Flaherty, 2007). Given that junior soldiers live in military dormitories by unit of assignment and have nearly around-the-clock workplace and off-duty interaction, I hypothesize that existing participation rates will affect the new member's own decision to participate in the CE program. The exogeneity of the military assignment process allows me to estimate a causal effect. I then decompose that estimate into effects from educational markets, leadership, local mentors, and peer effects. Gauging the relative importance of such mechanisms is important because it could guide the design and implementation of effective policies to encourage human capital investment.

This work makes several contributions to the existing literature. First, I add to the rigor of current research on social interaction by exploiting, as does MTO, random assignment to study the

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impact of environmental and peer influences on important individual decisions and outcomes. Second, I estimate the effect of the peer continuing education participation rate on the new member's own CE participation decision, thereby providing causal evidence at the extensive margin of education. Third, this study examines the social context of education decisions made by young, working adults – a non-traditional student population that is growing across higher education (Seftor and Turner, 2002; Deming, Goldin, and Katz, 2012).

I find that a new soldier assigned to a high-participation company is 16 percentage points more likely to use CE than a soldier assigned to a low-participation company. This is a sizable impact given that only 11 percent of the new soldiers in the sample participate in CE. Building on prior work examining neighborhood and peer effects, I decompose this overall impact into neighborhood, leadership, and peer influences. This decomposition suggests that differences across Army locations and other common shocks are largely responsible for the impacts I observe, though I also find a modest peer effect on continuing education participation.

The rest of the paper proceeds as follows. Section II provides background information on the Army and its subsidized continuing education program. Section III describes the data. Section IV details the empirical strategy. I present results and discussion in Section V. Finally, Section VI concludes.

II. Background

A. US Army Structure

The US Army is a large and structured organization consisting of brigades, battalions, and companies. Figure 1 depicts the structure of a brigade, which consists of about 4,500 soldiers. The hierarchical level of interest in this study is the company, of which there are about 30 in a brigade. Within a company, the officers and sergeants are responsible for day-to-day operations as well as the training and mentorship of the soldiers in the company. The approximately 60 junior enlisted soldiers in the company are the peer group that I study in this paper. New junior soldiers join the company after completing their initial military training, commonly referred to as "boot camp." In Section IV of the paper, I discuss the military assignment process for these junior soldiers, with special attention to the resulting randomness.

When the unit is at home station and not deployed overseas, unmarried junior soldiers reside by company in Army-provided dormitories (or "barracks") that feature two- or three-person rooms, administrative offices, and indoor and outdoor leisure spaces. Since the soldiers living in barracks

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have nearly around-the-clock interaction, both during the work day and in their off-duty time, it is reasonable to expect that they are a prominent information source for and peer influence on one another. Moreover, a soldier who lives in an Army barracks cannot help but to notice how his peers down the hall are allocating their off-duty time – whether for continuing education participation, physical fitness, or other leisure activities. The combination of these elements creates a social environment at the company level that is suitable for studying peer influence.

B. Tuition Assistance

Tuition Assistance is a voluntary continuing education (CE) program that subsidizes college classes for service members. The program is subject to subsidy caps by credit hour and total expenditure per year by soldier, but the generous benefit levels easily cover part-time participation in college – taking one or two classes at a time – for the participating soldier.[2] The Army administers the Tuition Assistance program through its on-post Army Education Centers, staffed by civilian personnel who are independent of the officers and sergeants to whom the soldier reports at the company level. Soldiers who want to participate in the CE program must seek out information either online or from a counselor at the Education Center, formally request Tuition Assistance, enroll in class, and then complete coursework during off-duty hours. Soldiers commit to only one class at a time, are able to start at any time in the calendar year, pending the availability of classes, and can either pursue individual courses or enroll in a degree program. Army Education Centers, working in partnership with institutions of higher education, offer classes in both online and traditional brick-and-mortar formats.[3] Among soldiers assigned to brigades in 2013, 12 percent took at least one Tuition Assistance course during that year while 24 percent had ever taken a course; those figures are 16 percent and 32 percent, respectively, if we consider only soldiers with at least 3 years of service in the Army.[4]

Given the generous subsidy available through Tuition Assistance, the low take-up levels for continuing education may seem surprising. However, participation requires an off-duty time commitment, since a soldier's work day (and sometimes his night) is full of military training and

[2] Since the subsidy caps are at the level of the individual soldier only, there is no risk that soldiers may "crowd out" one another or be forced to compete for resources within the program.

[3] CE is wholly separate from and has no effect on GI Bill benefit eligibility (used after leaving the service) and Army skills-based educational programs, like parachutist training or military leadership training in conjunction with promotion to sergeant.

[4] Analysis is based on 153,746 enlisted soldiers assigned to brigades in 2013; 87,339 of those soldiers had 3 or more years of service in the Army. Tuition Assistance use by officers is uncommon because they incur extra time in the service for taking classes, whereas the enlisted do not.

there are no modifications to his duty requirements to support completing CE coursework. There is also some risk of financial obligation: soldiers must repay the subsidy if they fail or withdraw from a class for reasons unrelated to military duty.[5] Moreover, many new soldiers (almost 90% - see Table 1) join the Army having completed high school and no college, so they may be unfamiliar with or have misconceptions about higher education in general. Also, since CE is not administered through his assigned company, there is no guarantee that the new soldier even knows about the program, particularly given that CE is a less prominent educational benefit than the longstanding and well-known GI Bill. As such, while CE presents a promising human capital investment opportunity, many soldiers might be unaware of or hesitant to pursue the benefit.[6] Thus, the attitudes and participation behavior around the company could be very influential in shaping individual CE outcomes – both for the new member and those soldiers already in the peer group.

III. Data

A. Sources

I rely on data from two sources. First, I draw administrative military data on enlisted soldiers from the US Army's Office of Economic and Manpower Analysis (OEMA); these records contain rich soldier-level demographic, financial, and occupational data from the point of entry into the service as well as through subsequent military assignment. Importantly, these data also include the specific dates when soldiers enter into and depart from the assigned company. Second, I draw individual-level data on CE course participation from Headquarters, Army Continuing Education Services (ACES). The CE data include start and end dates for each class taken, so I observe program participation by month for each soldier. One limitation of the CE data is that many (nearly 40%) course grades are missing while others are simply pass/fail. Accordingly, I analyze only participation and not performance in this study.

B. Sample

I focus on new soldiers assigned to any active Army brigade that did not deploy overseas in the years 2012-2013; there are seven such brigades. The purpose of this sample selection is to establish baselines both for access to CE and personal discount rate, both of which are important

[5] If a soldier fails or withdraws for a military-related reason (such as intensive home-station training prior to a combat deployment), the soldier can request a memorandum from his commanding officer to waive subsidy repayment.
[6] Castleman (2015) notes that a lack of visibility of opportunities in higher education likely constrains participation in those opportunities. This information problem and other types of barriers to higher education have received increased attention in the recent college access literature; Page and Scott-Clayton (2016) provides an excellent survey.

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for educational decision-making and might be influenced by a current or impending combat deployment. First, soldiers have little to no access to Army Education Centers and CE courses while deployed overseas. Second, any investment in education requires accepting present cost in the hope of gaining future benefit; a soldier who is anticipating a combat deployment might evaluate this tradeoff with a high personal discount rate given the imminent risk of personal harm that he faces. Thus, while new soldiers who did not deploy in 2012-2013 are not systematically different at entry from those who did deploy, I condition my sample on this critical unit-level treatment (deployment) for the reasons just described. Appendix A contains more details on sample selection.

Across the seven brigades and two years in my preferred sample, I identify 10,141 junior enlisted non-married soldiers who were newly assigned to a company in the brigade and stayed in that company for at least 9 months.[7] These soldiers were newly assigned across 186 companies in those brigades during that time period. Table 1 provides summary statistics on these soldiers and the companies that they joined. As shown in Panel A, the new soldiers are young (21 years old) on average and about 90% have completed no college. Approximately 60% of the new soldiers are white and more than 90% are male.[8] The outcome of interest is a binary variable for each newly assigned soldier indicating whether he has participated in CE – taking at least one class – by the 9 month mark of assignment to the company; 11% in this sample participated in CE within that timeframe. An advantage of focusing on new soldiers is that I know their earlier exposure to Army CE to be zero; these soldiers were previously in boot camp, where there is no access to CE, and so they had no prior exposure to the CE program. The company-level statistics in Panel B are averages across the 186 companies and 24 months of observation. The key explanatory variable is the percentage of junior soldiers that either were currently using or had recently used CE while assigned to that same company; the mean of this variable is 5.7% across all companies in the sample.[9] Figure 2 shows that there is significant variation in this treatment variable.

[7] I exclude married junior soldiers from this study because they reside with their families in private quarters and are away from important social interaction that occurs after duty hours in Army-provided company-level barracks. The 9-month window ensures that each new soldier, regardless of what month he joins the company, will get exposure to that company's existing CE environment and experience two traditional quarter-based course starts. Later in the paper, I test the robustness of the results to each of these design considerations.

[8] The sample is disproportionately male (relative to overall Army demographics) because of Army regulations concerning how females can be assigned to small units with direct combat missions (such as within a combat brigade) – please see footnote 10 for more details.

[9] I expect the average recent CE use rate (5.7%) to be lower than the average outcome variable (11% CE use rate for new soldiers) because of the strictness by which each figure is measured: I define recent use as occurring within the last 3 months whereas the outcome variable measures any CE use within 9 months.

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IV. Empirical Strategy

A. Social Influence and Military Assignments

I quantify each Army company's human capital investment environment on a monthly basis as the CE participation rate of the soldiers already assigned to that company. This company participation rate – the basis for estimating the causal effect of social influence – is the product of all factors that may in turn influence the individual's CE participation decision: peer effects, but also differences in educational markets across Army locations, differences in command emphasis on continuing education, differences in local mentor CE participation, etc. In subsequent sections I attempt to decompose the overall social influence into specific mechanisms, such as neighborhood-level effects and peer effects.

To estimate a causal effect attributable to social influence, I rely on Army conditional random assignment (CRA) of soldiers to companies. The Army arbitrarily assigns its junior enlisted members to companies based on established personnel processes that prioritize the "needs of the Army,"[10] not based on the preferences of the soldier and certainly without regards to variation in CE participation across companies. For example, the Army may assign two soldiers with tank driver specialty to two different companies, one with high CE participation and the other low. Those assignments are conditional on the soldiers' specialties (tank driving) and the companies' needs (tank drivers), but otherwise arbitrary and therefore unrelated to anything else about either soldier.

In addition to the established personnel processes that underlie CRA, there are three further reasons to expect randomness in the assignment of new soldiers to company CE rates. First, as already mentioned, entry-level soldiers have no exposure to CE in boot camp – so even if they could influence their assignment to a company, they would have no basis to angle for placement in a high participation company. Second, since basic training soldiers do not receive individual performance reports and there is no interview process for the next job, there is no clear means by which a company commander might measure the quality of or attempt to influence the assignment of the new tank driver (or any other new soldier) that the company is due to receive. Third, the only organization that could calculate unit CE participation rates – ACES, which provided me the soldier

[10] Department of Defense Directive 1315.07 and Army Regulation 600-14 provide the regulatory basis for CRA. Other researchers have used versions of this identification strategy, including Angrist and Johnson (2000), Carrell and Zinman (2014), Carter and Skimmyhorn (2016), and Carter et al. (2016). Army Regulation 600-13 provides the further stipulation that female soldiers cannot be assigned to units that have a routine mission to engage in direct combat, or to units which co-locate with units assigned a direct combat mission. Many of the units depicted in Figure 1 – like the tank battalion or an infantry company – are assigned direct combat missions and so are male-only during the time period considered.

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participation data – has no role in the military assignment process. Thus, it is reasonable to expect random assignment of soldiers to companies with varying CE participation rates.

I confirm that a natural experiment results from CRA by comparing, in Table 2, the baseline characteristics of soldiers assigned to companies with differing levels of CE participation. Column 1 presents a regression of the existing CE participation rate – measured in the company the month before[11] a new soldier arrives – on the assignment controls: rank, career field, time and their interactions along with gender. In column 2, I add a vector of entry characteristics – including AFQT, education level, and age – to the assignment controls. None of the entry characteristics added in column 2 is statistically or economically significant; they are also jointly insignificant at conventional statistical levels (F=1.52, p-value = 0.136). These analyses confirm that soldiers, conditional on rank, career field, Army requirements, and gender, are randomly assigned to companies. Put another way, personnel managers in the Army are <u>not</u> considering the personal characteristics of new soldiers – beyond what is mandated by normal assignment regulations – when placing them into CE participation environments.

Figure 3 demonstrates the timeline by which I use the plausible exogeneity stemming from Army CRA to test for the effect of social influence on individual CE participation. I measure the *ex ante* CE rate of the company at time t-1, or the month before the new soldier joins the company. The soldier joins the unit at time 0 and then I observe him again in the future for a CE outcome, with a binary cumulative assessment of his participation at 9 months.

Given the randomness resulting from the military assignment process and the timeline in Figure 3, I estimate an OLS model to test for the causal effect of social influence on CE participation:

$$CEPart_{ijt} = \alpha_0 + \alpha_1 * \overline{CEPart}_{j,t-1} + \alpha_2 * X_{ij,t-1} + \alpha_3 * A_{crt} + e_{ijt} \quad (1)$$

In equation (1), $CEPart_{ijt}$ is the outcome of interest: a binary variable indicating CE participation for soldier i assigned to Army company j at time t. α_0 is the regression intercept. $\overline{CEPart}_{j,t-1}$ measures the existing CE participation in the company, the month before new soldier i arrives; $\overline{CEPart}_{j,t-1}$ can be either a rate or a set of indicator variables for quartile of assignment, where quartile is based on the relative CE rate of the company (see Figure 2). $X_{ij,t-1}$ is a vector of

[11] The use of a lagged peer measure – here the CE rate the month before the new soldier arrives – is a strategy that some authors (Hanushek et al, 2003; Burke and Sass, 2013) have used to deal with simultaneity issues in peer effects studies. I discuss this empirical challenge in the next section.

individual characteristics (like aptitude, entry education level, and age). A_{crt} are the assignment control fixed effects, which are career field, rank, time (month*year), and gender. Given the randomness resulting from Army CRA, α_1 provides an unbiased estimate of the pre-assignment environment's effects ("social influence") on the individual's future CE decision.

B. Decomposing the Social Effect

To inform policy and resourcing decisions, it is important to distinguish among the mechanisms driving any social influence on individual human capital investment decisions. Whereas I argue above that the estimate for social influence is internally valid due to CRA, I acknowledge here that disentangling any potential peer effect from the overall social effect is a more challenging empirical problem. Manski (1993) provides a well-known framework for understanding why individuals who belong to the same social group might behave in the same way or make similar choices. The mechanisms he considers are peer actions, peer characteristics, and correlated effects. In the current context, the peer action is contemporary CE participation; peer characteristics include group measures such as aptitude, education, and age that might influence human capital investment; and correlated effects are common background factors such as the local Ed Center and the proximity of colleges and universities to each battalion. Some authors (Lyle, 2007; Angrist, 2014) refer to the correlated effects as "common shocks" to emphasize the effect these factors have on all members of the social group.

I start with a traditional linear-in-means specification, capturing the elements in Manski's model and similar to that used by Sacerdote (2001) and other authors:

$$CEPart_{ijt} = \alpha + \beta * \overline{CEPart}_{-jt} + \gamma * X_{ij,t-1} + \sigma * A_{crt} + \delta * \bar{X}_{j,t-1} + \mu * Z_{jt} + \varepsilon_{ijt} \quad (2)$$

Although this specification resembles equation (1), there are a few important differences. First, $\overline{CEPart}_{-jt}$, the explanatory variable of interest, measures *contemporaneous* peer participation: the average CE participation rate among soldier i's peers in the company at time t, excluding individual i. In the core model discussed earlier, I use the *ex ante* rate first to establish random assignment and then second to identify a causal effect. Here, to explore mechanisms in the framework put forth by Manski, I use the contemporaneous rate in order to provide a precise measure of what the peers are doing in the current period. Next, $\bar{X}_{j,t-1}$ are the mean characteristics of the company peers the month before new soldier i joins; this is the peer characteristics channel of influence. Finally, Z_{jt} are correlated effects – background factors such as the local educational environment and leaders that potentially impact the CE participation decision of all members of the company. ε_{ijt} is the error

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term. While this model is more complex than that in equation (1), it helps me to separate underlying mechanisms whereas the core model identifies only the overall impact of social influence.

As is well documented in the peer effects literature (Sacerdote, 2001; Hanushek et al, 2003; Angrist, 2014), there are some empirical challenges in causal interpretation of the contemporaneous peer effects parameter β from equation (2). Even though Army CRA removes worry of selection into the peer group, there are two other potential problems. First, there is risk of unobserved correlated effects that might not be picked up in the vector Z_{jt}. These could relate to organizational culture, attitudes about continuing education, or another unobservable factor related to CE participation both by the peer group and the new soldier; failing to account for these could create a source of bias. Second, the simultaneity of $CEPart_{ijt}$ and $\overline{CEPart}_{-jt}$ presents a major identification challenge in estimating (2). This is what Manski terms the "reflection problem," insomuch as the researcher cannot be sure whether the peer group is influencing the individual, the individual is influencing the peer group, or both.[12] Nonetheless, estimating (2) can give a rough idea of the relative sizes of mechanisms, and, in the case of a large and statistically significant estimate for β, suggests that the researcher can reject a null hypothesis that there are no peer effects present.

Within the Manski model, I can apply a fixed-effects framework to address potential bias stemming from unobservable correlated factors. The hierarchical structure of the military makes such a framework particularly effective, as demonstrated in Lyle (2007). Army base and time fixed effects within Z_{jt} soak up location-specific or time-specific determinants of continuing education participation, which could include differences in the density of participating higher education institutions around different Army bases. Another important factor unique to any given Army base is the local Education Center, which may have different course offerings and outreach capability – like from education counselors – when compared to other Ed Centers at other Army locations. There could also be seasonal factors that influence CE participation, perhaps related to when courses typically start. The Army base and time fixed effects control for all of these possible confounders. Additional fixed effects at the battalion level account for the intensity of unit training and day-to-day operations, leader emphasis on continuing education, and barracks location relative to the Army Education Center. Finally, I add the CE participation rate of the sergeants by unit and

[12] The reflection problem is a significant empirical concern in the well-known scenario of two peers who are college roommates. It may be less of a concern in the current setting, in which the new soldier is junior to 59 peers who are already assigned to the company – I investigate this possibility at the end of Section V.

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month to allow for the influence of a natural mentor network as well as local attitudes and encouragement for education within the assigned company.

The reflection problem, on the other hand, remains an enduring challenge in analyses of social interaction. Some authors (Gaviria and Raphael, 2001; Fletcher, 2015) have turned to instrumental variables (IV) methods to enable causal estimation of equation (2), while others (Brock and Durlauf; 2001, 2007) have examined identification within structural models of binary choice.[13] The simultaneous equations approach used by Case and Katz (1991) and Sacerdote (2001) provides a middle ground to addressing the reflection problem and has become a convention in the peer effects literature. Using this approach, the simultaneity of peer outcomes gives a second equation – very similar to (2) – that captures the influence of the individual on the group outcome. I present both equations below for ease of visual comparison:

$$CEPart_{ijt} = \alpha + \beta * \overline{CEPart}_{-jt} + \gamma * X_{ij,t-1} + \sigma * A_{crt} + \delta * \bar{X}_{j,t-1} + \mu * Z_{jt} + \varepsilon_{ijt} \quad (2)$$

$$\overline{CEPart}_{-jt} = \tilde{\alpha} + \tilde{\beta} * CEPart_{ijt} + \tilde{\gamma} * X_{ij,t-1} + \tilde{\sigma} * \mathrm{A_{crt}} + \tilde{\delta} * \bar{X}_{j,t-1} + \tilde{\mu} * Z_{jt} + \tilde{\varepsilon}_{ijt} \quad (3)$$

Combining (2) and (3) gives the following reduced-form equation:

$$CEPart_{ijt} = \pi_0 + \pi_1 * X_{ij,t-1} + \pi_2 * \bar{X}_{j,t-1} + \pi_3 * Z_{jt} + \nu_{ijt} \quad (4)$$

Equation (4) still includes measures of peer *characteristics* within the vector $\bar{X}_{j,t-1}$ but excludes the simultaneous term, $\overline{CEPart}_{-jt}$, that is a measure of contemporary peer action. This step mechanically removes the reflection problem and concerns about simultaneity. The reduced-form coefficients in (4), such as π_2, are composite of parameters from (2) and (3). More precisely,

$$\pi_2 = \frac{\beta\tilde{\delta}+\delta}{1-\beta\tilde{\beta}} \quad (5)$$

after inserting (3) into (2) and collecting terms. The β terms measure the peer actions channel while the δ terms are from the peer characteristics channel. Based on the complexity of the relationship in equation (5), the researcher would need to make very strong assumptions about several parameters to identify any one structural parameter of interest, say β, even after first obtaining an estimate for π_2 from equation (4). Nonetheless, the estimate for π_2 gives well-identified evidence of peer effects (i.e. – free of simultaneity bias) in the reduced form, even though it does not completely untangle the mechanisms of peer influence that the estimation of equations (2) and (3) attempts to address.

[13] In the IV case, it is difficult to justify the exclusion restriction in this setting, namely that the instrument affects CE participation only through the participation rate of the group. The Brock and Durlauf model argues that the reflection problem does not arise in the binary choice setting as long as a large support assumption holds for the observable peer characteristics vector. Under such a condition, the expected value of the peer group choice, bounded between -1 and 1, cannot be linearly dependent on the peer group characteristics.

V. Results

A. Social Influence

Using least squares estimation of equation (1), I find that existing company participation has a strong effect on the CE investment decision of a newly assigned soldier. When the treatment variable $\overline{CEPart}_{j,t-1}$ is a rate of unit participation, the point estimate for the causal parameter is 1.02. This linear-in-means result indicates nearly one-for-one movement between the new soldier's CE outcome and the corresponding peer participation rate. Given a standard deviation in unit participation rates of 0.06, the effect size is slightly larger than 6 percentage points (pp). This is a sizeable effect given that only 11 percent of the new soldier sample use CE during the period of observation. These regression results appear in Appendix B.

My preferred model for social influence uses a more flexible specification in which the treatment variable $\overline{CEPart}_{j,t-1}$ is a set of indicator variables for quartile of CE assignment. These results appear in Table 3. Using this nonlinear specification allows the treatment effect (from the *ex ante* CE participation rate) to vary at different points across the distribution of company CE participation. As suggested by the histogram in Figure 2, a top quartile CE company has participation rates of 10 percent or greater while a bottom quartile company has rates lower than 2 percent. In a company of 60 junior enlisted soldiers, these rates equate to a half-dozen or more peers taking classes in a top company versus none or maybe only one using CE in a bottom company. Upon estimating equation (1) with the indicator variables for CE quartile, the results are once again large and statistically significant: a soldier assigned to a top quartile CE company is 16 percentage points more likely to use CE than a new soldier assigned to a bottom quartile CE company, where only 5 percent of new soldiers on average will participate in CE. Similarly, a soldier assigned to the second highest quartile of CE participation is 7 percentage points more likely to use CE. Soldiers assigned to either of the bottom two quartiles of CE participation companies are far less likely to use the benefit. The estimates in Table 3 are robust to the full set of new soldier demographic controls (added in columns 2 and 3), confirming the conditional exogeneity via military assignment that was discussed in Section IV.[14] [15]

Estimation of equation (1) also reveals some heterogeneity in CE participation, as shown in Table 3. Service members who already have a college degree – only about 3% of the sample – are

[14] Probit marginal effects, evaluated at the means of explanatory variables, return similar estimates.
[15] The existing CE rate in the company has no impact on the number of courses taken - I find influence only on the decision to take a first class, and not on how many courses to take.

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far less likely to use CE. The likelihood of participation increases slightly in the age of the new soldier: about 0.4 of a percentage point per year. Nonwhite soldiers and females are more likely to use CE than their white male counterparts; these results are consistent with descriptive findings in earlier studies of CE programs both in the military (Garcia, Arkes, and Trost, 2002; Sticha et al., 2003) and outside the military (Flaherty, 2007).[16]

B. Decomposing the Social Effect

In this section, I shift to the more complex specification in equation (2) in an attempt to separate out the mechanisms driving the overall social effects just discussed. I separately estimate the full peer effects model in (2) using each of the *ex ante* and contemporaneous peer participation rates. I address some advantages and disadvantages of each approach.

First, I first estimate a modified version of equation (2) in which I include the mean peer characteristics and common shocks as regressors alongside the *ex ante* CE participation rate and individual characteristics. One advantage of this approach, as noted earlier, is to circumvent the reflection problem by using a lagged peer treatment rather than the contemporaneous measure. For this estimation, I increasingly layer on covariates in order to address the confounding influence of peer characteristics and correlated effects. The covariates that I add are mean peer characteristics by company, fixed effects for Army base, fixed effects for the battalion (higher headquarters) to which the company is assigned, and finally the contemporary CE rate of the sergeants assigned to the company. With the full set of these confounders included, the impact of the *ex ante* peer rate decreases by more than 80% and loses statistical significance at conventional levels (results in Table B1 in the appendix). This initial estimation suggests that common shocks from location, leadership, and mentors play a large role in the effects observed and that peer effects are non-existent or negligible.

Next, I estimate the canonical linear-in-means peer effects model in equation (2), with peer actions entering now through the *contemporaneous* participation rate, consistent with the social interactions framework discussed in Section IV. Regression results appear in Table 4. The outcome is still the binary CE participation outcome of the newly assigned soldier. Per equation (2), the

[16] As an immediate robustness check, I estimate equation (1) for only the male soldiers in the sample; these results appear in column 4 of Table 3. As discussed in footnote 10, Army assignment policies forbid the assignment of females to direct combat units and so females are therefore assigned to non-direct combat units with peers that may have better access to and inclination to use CE. Moreover, since females in this study are more likely to participate in CE, it could be that this subset of soldiers is driving the results thus far. This is clearly not the case here, as shown in column 4 of Table 3. The strong social effects are identical for the male soldiers alone as for the entire sample, which is not entirely surprising since the sample is more than 90% male.

explanatory variable of interest is the contemporaneous CE participation[17] of the new soldier's peers during the 9-month window – this is the peer actions channel of influence from Manski's framework. As I progress across regression specifications in Table 4, I increasingly layer on covariates in order to address the confounding influence of peer characteristics and correlated effects. In column 2 of Table 4, I add peer mean characteristics (aptitude, education, age) to the regression; there is a small decrease in the estimated effect of peer actions on new soldier CE participation. However, in column 3, the inclusion of Army base controls lowers the coefficient on the peer CE rate from 1.372 to 0.734 – nearly a 50% reduction. Since the location control is a fixed effect only, it is not possible to pinpoint the exact mechanism at work, but the local education market (on-post Education Center, counselors at that center, course offerings, etc.) may be an important factor. I discuss the importance of local education markets and common shocks in more detail in Section VI. Adding the battalion controls in column 4 further reduces the topline coefficient to 0.554. Again, since this control is a fixed effect only, I am unable to identify a mechanism, but it could be that the intensity of day-to-day operations or the leadership attitudes towards CE in the higher headquarters are important factors in individual decision-making. Finally, adding the participation rate of the sergeants in column 5 reduces the coefficient on the peer CE rate to 0.439, indicating that these local mentors affect both the new soldier and the junior soldier peer group. With the full covariate set included, the point estimate on the contemporary CE rate indicates that exposure to a 10 percentage point increase in peer CE participation increases the likelihood of own CE participation by 4.39 percentage points.

Even though there are concerns about simultaneity when estimating peer effects with the contemporaneous rate, as above, there are two important takeaways from the results in Table 4. First, even with the reflection problem potentially present, the point estimate in column 5 provides suggestive evidence against any null hypothesis that there are no peer effects present. Second, the "decay" in coefficient on the peer CE rate across specifications is indicative of the role played by common shocks; this is consistent with results in Hanushek et al. (2003) and Lyle (2007). Thus, taken collectively, my analyses indicate that environmental and social factors have a substantial influence on individual human capital investment decisions, but that even after controlling for these

[17] The results of applying fixed effects for the decomposition are similar whether the peer CE variable is the company rate (linear-in-means model) or the set of indicators for company participation quartile (non-linear specification in section A above). I present and discuss results here using the former for ease of exposition.

factors, peers still appear to influence the participation decisions of individuals when they join a new group.

C. Exploring the Reflection Problem

In this section, I examine the potential for simultaneity problems in this context when estimating the peer effects model with the contemporaneous rate. The analysis that follows suggests that the reflection problem in this setting is nonzero but perhaps less prominent than in other previously studied environments.

In some higher education settings, the reflection problem is symmetric: the simultaneity of outcomes occurs as two peer roommates – often both freshmen in college – influence one another. The current setting is different insomuch as the newly-assigned soldier joins approximately 59 peers who have already been in the company, some for multiple years. To test whether that new soldier influences the longer-tenured peers, I estimate equation (3), in which the outcome is the contemporaneous peer CE rate at 9 months and the key explanatory variable is the new soldier's binary participation decision.[18] Estimation proceeds similarly to that in the section above and I layer on the same confounding covariates here that appear in the columns of Table 4. Results for this analysis appear in Table 5. The new soldier's CE choice is significant in all models; the movement in topline coefficient from 0.0285 (column 1) to 0.00846 (column 5) is reminiscent of results observed in Table 4 and again suggests prominent common shocks. The point estimate in column 5 of Table 5 reveals that CE use by the new soldier is associated with a nearly 1 pp increase in the peer CE rate. While it may seem surprising that the new soldier has this influence on the incumbent peer group, the magnitude of the effect (0.00846 x 59 peers) suggests that the induced takeup is, on average, only one half of one person in each company. Data limitations prevent me from examining whether that new user is a roommate or a friend who lives a few doors down, as we might expect in a dormitory-like setting. Nonetheless, this important result confirms that simultaneity (the reflection problem) plays a small but non-trivial role in this setting.

D. Reduced-Form Peer Effect

In this section, I estimate equation (4) in order to provide evidence of a peer effect that is fully identified – this is complementary to the main analysis of peer effects already discussed. I find that new soldiers assigned to older peers are more likely to participate in CE. This reduced-form

[18] Calculation of the peer CE rate at 9 months excludes the new soldier. It is important to caution that this is exploratory analysis, since the parameters in (3) are not fully identified due to the same simultaneity concerns discussed in Section IV for equation (2).

peer effect is modest in magnitude and statistically significant at conventional levels. See Appendix C for more details.

E. Robustness Checks

Finally, in this section, I vary some important design features of this study in order to explore the robustness of the results. First, throughout the paper, I measured the new soldier's CE participation outcome at the end of 9 months in the company. The purpose of this timeframe is to permit adequate time for receipt of existing CE rate "treatment" plus the passing of two traditional quarter course starts.[19] As a robustness check, I re-estimate (1) and (2) with different durations of observation for each new soldier, since the summary statistics in Panel A of Table 1 show that some new soldiers do take up CE almost immediately. With CE use by the 3 month mark as the outcome, the environment effect is small and the estimated endogenous peer effect coefficient is null. For the 6 month time horizon, the effects are statistically significant but smaller than those observed for the 9 month outcome. The results for 12 months mirror those for 9 months (results also not shown). The results for the shorter time horizons make intuitive sense: the "very early" takers of the CE benefit are making participation decisions in the first 3 months that are unrelated to social influence. Participation decisions made in the 6 or 12 month timeframe reveal a similar role for social influence when compared to estimation at 9 months. I do not estimate effects for longer time horizons – such as 18 months – since more than a third of the soldiers in the sample change companies before that timeframe. The models with a 9-month outcome remain my preferred specification.

I also excluded married soldiers from the preferred sample in order to ensure uniform "full" treatment that includes those important off-duty social interactions that occur in Army barracks (recall that married soldiers, even if junior enlisted, reside in separate living quarters with their spouses, away from the company barracks). As a second robustness check, I re-estimate the main results with the married soldiers included; this step increases the sample size by about 20%. For the test of social effects in equation (1), including the married soldiers reduces the treatment effect about 10% in the linear specification. The reduction is steeper – about 20% – in the nonlinear specification: the top quartile company participation effect is 13 pp instead of 16 pp. Interestingly, the peer effects results are much smaller with the married soldiers included. The linear-in-mean peer effects specification in (2) returns a coefficient of 0.254 for this larger sample, compared to 0.439 for

[19] Although the CE courses start throughout the calendar year, the four most common starting months (January, March, August, October) account for more than 50% of course starts. Any new soldier staying in a company for 9 consecutive months will see at least 2 of these most common starting months. Analysis of CE course timeframes is based on more than 780,000 courses from 2010 through 2015.

the non-married soldiers only. The reduced-form coefficient on peer mean age from equation (4) also decreases by more than 25% and loses statistical significance (p-value=0.15). It is unsurprising that these estimates appear to be "watered down" when compared to the main results that exclude the married soldiers; these individuals are away from the company barracks during those critical off-duty times when peers might be working on coursework or at least discussing the potential costs and benefits of the CE program. Thus, these results are as expected and confirm the importance of the round-the-clock social interaction in contributing to the main effects observed in this study.

In a final robustness exercise, I apply the models discussed in this paper to the new soldiers and Army units excluded from my preferred sample because of a combat deployment in 2012-2013. I find much lower participation in CE and no evidence of peer effects in CE uptake among these soldiers in the deployed units. There is only weak evidence of overall social influence on CE participation – this is the baseline measure as estimated in equation (1). These results suggest that combat deployment or impending deployment has a strong negative impact on continuing education, as hypothesized, both on takeup as well as on the social context that might encourage takeup. Please see section B of Appendix A for more analysis and discussion of these supplemental results.

VI. Discussion

In this paper, I study new US Army soldiers who are randomly assigned to companies that vary substantially in their existing participation rates in a subsidized continuing education program. I find that a new soldier assigned to a high-participation company is far more likely to take classes than a soldier assigned to a low-participation company. I find that differences across Army locations and other common shocks are largely responsible for the impacts I observe, while peers exert a smaller yet nonetheless significant effect.

I find evidence of social influence and peer effects in this study in spite of the generally low use of the Army's generous CE benefit, i.e. – a company at the 75th percentile of participation shows only 10% of its soldiers as recent program users. Similarly, even when excluding the most junior personnel (two or fewer three years in the Army), no more than 1/3 of soldiers have *ever* used the CE benefit. As mentioned in Section II, the low participation rates could be related to the risk of financial obligation (upon failing a class or withdrawing), general unawareness, time use constraints, or more likely a combination of all of these factors. It is an open question whether higher overall

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takeup would lead to stronger social influence and peer effects – particularly on new group members. This is a topic for future research.

My work also finds that peer actions are but one component of the larger social influence that can shape the human capital investment decisions of a new group member. Even in the unique environment that I study – featuring random assignment and voluntary CE participation in military barracks during off-duty time – peer effects are modest and certainly not independent of correlated factors that define the educational environment. This finding is consistent with the common shocks results in Hanushek et al (2003) and Lyle (2007) and reinforces the need for a total-environment approach to the study of peer effects and social interaction in general.

Finally, the paper demonstrates that a new worker is unlikely to use firm-sponsored CE if she does not have many peers who are using the program. This result may generalize to other academic settings and populations beyond just continuing education and the military. These potential learners – whether adolescents or adults – who are in environments that are not encouraging of investment in education could be another type of the "missing student" described in Hoxby and Avery (2013). This is a significant policy concern. Since it can be costly or even infeasible to re-shuffle peers to improve exposure to human capital investment, it is important to remember that peers only partially account for the CE outcome of the adult learner. Specifically, in the context of this study, I find that the educational environment exerts a large influence on participation and I suggest that factors within that local environment such as the density of local institutions, Education Center counselors, and local mentors could be particularly important.

Of general interest, it is important to assess which factors – peers but also other common shocks – in other settings are likewise influential in human capital investment decisions, whether for attending college, using CE in the workplace, or leveraging other opportunities to learn. Such assessments should guide resource allocation (say, for guidance counselors or course offerings) or even the design of interventions to encourage participation in education (like that for high-achieving, low income high school students discussed in Hoxby and Turner, 2013). Thus, a fruitful topic for future research is to investigate which specific aspects of the educational environment might encourage participation, particularly in general settings outside continuing education and the military, and to quantify their effect on promoting investment in human capital.

Appendix A – Sample Selection

A. Military Deployment

I base my sample selection on two confounding factors related to individual decision-making in higher education – program access and personal discount rate – that may be especially important in a military context. First, soldiers have little to no access to Army Education Centers and CE courses while deployed overseas.[20] Second, any investment in education requires accepting present cost in the hope of gaining future benefit; a soldier who is anticipating a combat deployment might evaluate this tradeoff with a high personal discount rate given the imminent risk of personal harm that he faces.

To control for these factors, I rely on two major Army events that bookend the period of study and guide my sample selection. First, the US military completed its planned withdrawal from Iraq in December 2011. This withdrawal subsequently reduced the number and pace of unit deployments to the Middle East and therefore reasonably reduced enlisted soldiers' expectations of future combat deployments, particularly if serving in a unit that just returned to home station. Second, in a policy change effective January 1, 2014, soldiers became ineligible to participate in CE within the first twelve months of their assignment to a company, meaning that any initial peer effect on an impressionable new soldier would have at best a one-year lagged effect. Accordingly, I focus on new soldiers in brigades in 2012 and 2013 that did not deploy in order to create baselines both for access to CE and for a soldier's own personal discount rate; each of these factors would otherwise be affected by deployment, impending deployment, or the one-year waiting period if assigned after 2014.

I include in the preferred sample all seven brigades that did not deploy for any part of the years 2012-2013, per the non-deploying and benefit access criteria described above. Four of these are traditional US Army ground combat brigades that returned to home station from a rotational combat deployment to either Iraq or Afghanistan in late 2011, one underwent a significant equipment transformation and retraining at home station between the years 2011-2013, and the remaining two conduct permanent mission functions for the Army that almost surely could not be interrupted for a deployment to the Middle East. Each of these circumstances not only precluded

[20] The Army has at different times maintained a few Education Centers in the Middle East theaters of operation, but only at major air bases. As such, these facilities were unavailable to the majority of Army soldiers serving in combat brigades on deployment and so home-station access to the CE program is an important consideration in this study.

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combat deployment for that brigade in 2012-2013, but also reasonably created an expectation that deployment was very unlikely: these are important conditions for human capital investment, as discussed. Table A1 shows that new soldiers assigned to brigades that did not deploy in 2012-2013 have slightly lower AFQT scores and more likely to be nonwhite, but otherwise are not systematically different at entry into the service from soldiers assigned to brigades that did deploy.

B. Social Influence in the Deployed Brigades

To explore the effects of deployment or impending deployment on human capital investment, I compare in Figure A1 companies and new soldiers from the seven brigades that meet the no deployment criterion ("sample") versus those from the 29 brigades that do not ("non-sample").[21] Each of the 29 non-sample brigades was deployed to the Middle East – with duty in Afghanistan or Kuwait – for some portion of 2012-2013. Here, unlike in Table A1, the differences are striking. These non-sample companies show lower aggregate CE participation and a compressed distribution of CE rates. New soldiers assigned to units in the non-sample also use CE with less frequency at every point of measurement (3 months, 6 months, 9 months). These descriptive findings are to be expected given that soldiers would have reduced (if any) access to CE during a combat deployment and presumably would think about human capital investments differently in the months before impending deployment. Unsurprisingly, when I estimate equations (1), (2), and (4) for the non-sample soldiers, there is only weak evidence of a social effect on CE participation and no evidence of peer effects.[22]

Appendix B – Linear Model for Social Influence

This appendix presents regression results from estimation of equation (1), in which the peer treatment variable is a rate of unit participation. As shown in column 4 of Table B1, the point estimate for the causal parameter is 1.02, meaning that a 10 percentage point (pp) increase in the peer CE rate leads to a 10.2 pp increased likelihood that the new soldier will himself use CE. The more general, nonlinear model whose results I presented in Table 3 remains my preferred specification for social influence.

[21] The 36 brigades discussed in this section are brigade combat teams: deployable units that feature the permanent assignment of soldiers to companies. There are also training brigades in the Army's force structure, but I exclude these from the analysis entirely since most of their manning consists of transient soldiers who cycle in and out of the unit based on start and end dates of military training. The units that conduct boot camp for new enlistees are an example of this type of training brigade.

[22] Results available from the author on request.

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Appendix C – Reduced-Form Peer Effect

In this appendix, I estimate equation (4) in order to provide evidence of a peer effect that is fully identified – this is complementary to the analysis of the endogenous peer effect already discussed. The estimates here are in the reduced form because it was an algebraic combination of structural equations that removed the simultaneity of CE participation outcomes and resulted in equation (4). As discussed in Section IV, the coefficients are composite of several structural parameters, meaning that any peer effect detected here acts through the multiple channels of peer actions and peer characteristics as in (5). Regression results for equation (4) appear in Table 6. The full specification in column 3 reveals that a one-year increase in the mean age of company peers leads to a 1.3 pp increased likelihood of own participation in CE (this is the coefficient on *peer mean age* in Table C1).. This peer effect is about three times as large as the increased likelihood for a one-year increase in own age. Across the entire sample of companies, the average mean peer age is 24 as shown in the summary statistics in Table 1. The 25th percentile and 75th percentile values for mean peer age are 23.3 and 24.9, respectively. Thus, the 75-25 difference is 1.6 years and the associated CE participation effect comparing assignment to 75th percentile versus 25th percentile peer mean age is approximately 2 pp. This is a modest peer effect – particularly when compared to the overall social effects found earlier that are much larger – but still noteworthy given that only 11 percent of the sample uses the CE benefit. It is important to remember that this effect occurs through both the peer action and peer characteristics channels because of the reduced-form coefficient.

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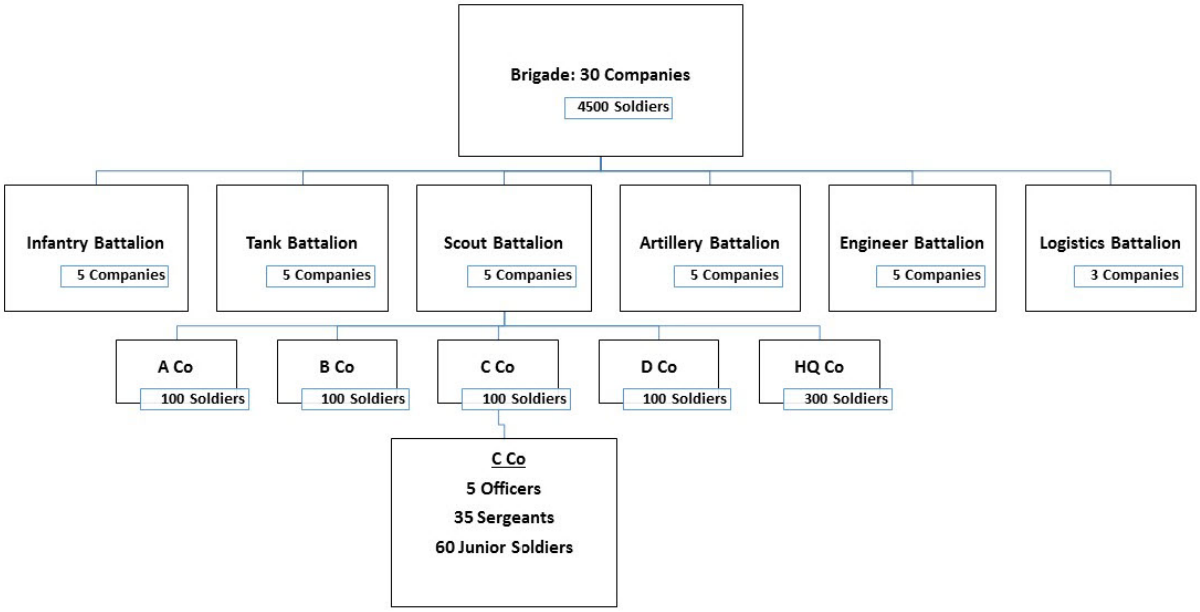
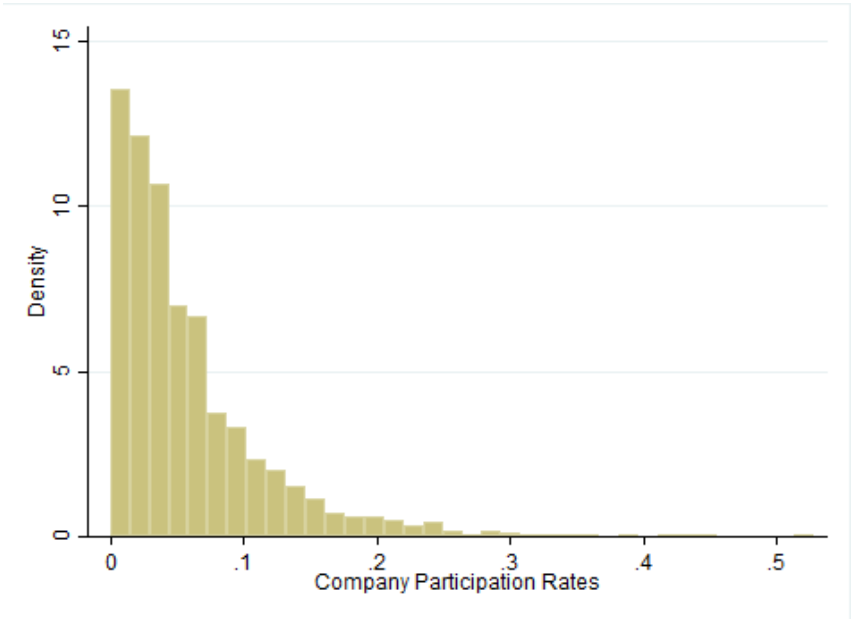
Figure 1: Organization of a US Army Brigade



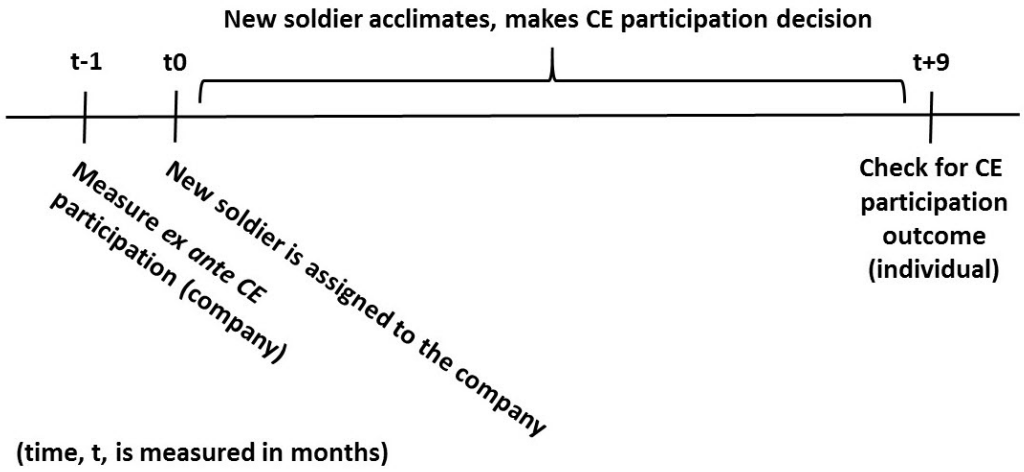
Note: Figure depicts the structure of a typical brigade in the US Army. The company is the hierarchical level of interest in this study, with the 60 junior soldiers as the peer group who is making human capital investment decision.

Figure 2: Monthly CE Participation Rates in Sample Companies, 2012-2013



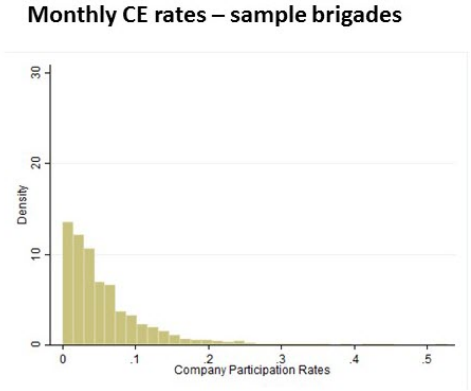
Note: DoD Data. Analysis is by month for companies that new US Army soldiers joined in 2012 and 2013. Horizontal axis measures fraction of assigned peer group in that company that are recent CE users. Histogram contains 36 bins, width 0.015. 14% of company-months show zero recent participation as of that month.

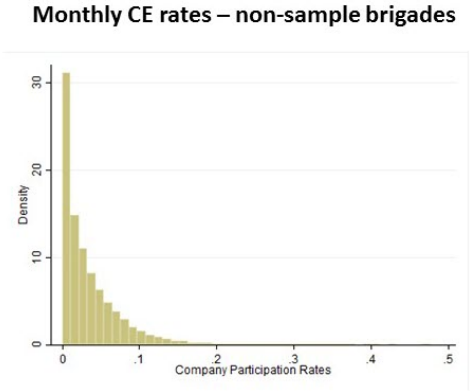
Figure 3: Timeline for Identifying the Effect of *Ex Ante* CE Participation on the New Soldier's CE Decision



Note: Figure depicts a timeline by month for social influence on human capital investment. The key peer variable, the CE participation rate, is measured the month before the new soldier joins the company.

Figure A1: CE Participation and Deployment, 2012-2013





New soldier CE use – sample brigades

	n	mean	sd
CE user by month 3	10141	0.06	(0.25)
CE user by month 6	10141	0.10	(0.29)
CE user by month 9	10141	0.11	(0.32)

New soldier CE use – non-sample brigades

	n	mean	sd
CE user by month 3	41763	0.02	(0.15)
CE user by month 6	41763	0.03	(0.18)
CE user by month 9	41763	0.05	(0.21)

Note: DoD Data. Analysis is by month for companies that new US Army soldiers joined in 2012 and 2013. Sample brigades are those that did not deploy in 2012-2013 (as in Figure 2) while non-sample brigades deployed to the Middle East for some portion of 2012-2013. Horizontal axis measures fraction of assigned peer group in that company that are recent CE users. Histograms contain 36 bins, width 0.015. 14% of company-months show zero recent participation as of that month in the sample brigades; 31% are zero in the non-sample brigades.

Table 1: Summary Statistics for Preferred Sample

Panel A. Newly Assigned Soldiers Who Spend at Least 9 Months in the Company					
	n	Mean	SD	Min	Max
AFQT	10141	57	18	22	99
GED	10141	0.03	0.18	0	1
high school graduate	10141	0.88	0.33	0	1
some college	10141	0.05	0.23	0	1
college graduate	10141	0.03	0.18	0	1
age	10141	21	2.83	18	44
white	10141	0.59	0.49	0	1
black	10141	0.21	0.40	0	1
Hispanic	10141	0.14	0.34	0	1
other race	10141	0.07	0.25	0	1
male	10141	0.92	0.28	0	1
female	10141	0.08	0.28	0	1
combat career field	10141	0.61	0.49	0	1
logistics career field	10141	0.39	0.49	0	1
CE user by month 3	10141	0.06	0.25	0	1
CE user by month 6	10141	0.1	0.29	0	1
CE user by month 9	10141	0.11	0.32	0	1
Panel B. Company*Month Average Values (186 Companies x 24 Months)					
	n	Mean	SD	Min	Max
company size (enlisted only)	4408	123	52	49	408
junior soldiers					
AFQT	4408	57	6	44	75
high school only	4408	0.90	0.05	0.61	1
some college only	4408	0.07	0.04	0	0.28
college degree	4408	0.03	0.03	0	0.20
age	4408	24	1.24	21	29
recent CE users	4408	0.06	0.06	0	0.53
sergeants					
AFQT	4408	55	6	41	75
high school only	4408	0.78	0.12	0.32	1
some college only	4408	0.17	0.10	0	0.63
college degree	4408	0.04	0.04	0	0.31
age	4408	32	2.00	27	38
recent CE users	4408	0.09	0.06	0	0.47

Sources: Office of Economic and Manpower Analysis and Army Continuing Education System.
"Recent CE users" denotes either currently using CE or having used CE in last quarter.

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Table 2: Conditional Random Assignment Test

Dependent variable is ex ante CE participation rate of assigned company
Explanatory variables are characteristics of the newly assigned soldier

	(1)	(2)
AFQT		0.000
		(0.000)
GED only		0.009
		(0.020)
high school only		0.006
		(0.019)
some college		-0.001
		(0.020)
college degree		0.012
		(0.020)
age		0.000
		(0.000)
black		0.001
		(0.002)
Hispanic		-0.000
		(0.002)
other race		0.003
		(0.002)
assignment controls (rank, career field, time and interactions; gender)	Yes	Yes
p-value for joint significance of entry characteristics		0.136
Observations	10141	10141

Standard errors in parentheses. I measure the dependent variable the month before the new soldier joins the company. This table demonstrates that personal characteristics of the new soldier have no bearing on treatment when assignment controls are included in the regression. This result underlies the identification strategy. Assignment controls are based on the applicable regulations that govern general assignment of service members (AR 600-14) and assignment of females to units with a direct combat mission (AR 600-13). The separately listed covariates are entry characteristics of the new soldier that are not considered in the assignment process.
* p<0.10, ** p<0.05, *** p<0.01

Table 3: New Soldier CE Participation and the Existing Company Human Capital Environment

Ex ante CE participation is measured by indicators for quartile of assignment
Binary dependent variable is new soldier CE use by month 9

	(1)	(2)	(3)	(4)
4th qtile (top) CE (junior enlisted)	0.156*** (0.019)	0.157*** (0.019)	0.157*** (0.019)	0.155*** (0.020)
3rd qtile CE (junior enlisted)	0.066*** (0.013)	0.066*** (0.013)	0.067*** (0.013)	0.069*** (0.014)
2nd qtile CE (junior enlisted)	0.009 (0.008)	0.009 (0.008)	0.009 (0.008)	0.007 (0.008)
AFQT		0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
some college		0.023 (0.015)	0.009 (0.016)	-0.000 (0.016)
college degree		-0.088*** (0.016)	-0.118*** (0.018)	-0.121*** (0.017)
age			0.004** (0.001)	0.004* (0.001)
black			0.040*** (0.009)	0.040*** (0.010)
Hispanic			0.024* (0.009)	0.019* (0.009)
other race			0.045** (0.014)	0.050*** (0.013)
female	0.0730*** (0.0144)	0.0768*** (0.0146)	0.065*** (0.016)	n/a
assignment controls	Yes	Yes	Yes	Yes
Observations	10141	10141	10141	9289

For columns 1-4, standard errors are clustered at the company level. 4th quartile CE companies have CE participation rates above 10 percent; 3rd quartile above 6 percent; 2nd quartile above 2 percent. Assignment controls include military occupation and year-month of initial assignment to the company. I exclude females from column 4 as an initial robustness check.
* p<0.10, ** p<0.05, *** p<0.01

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Table 4: New Soldier CE Participation and Contemporary Peer CE Participation

Contemp CE rate is measured by participation within last 3 mos
Binary dependent variable is new soldier CE use by month 9

	(1)	(2)	(3)	(4)	(5)
contemp CE rate (junior enlisted)	1.437*** (0.159)	1.372*** (0.136)	0.734*** (0.199)	0.554*** (0.160)	0.439** (0.169)
AFQT	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
some college	0.008 (0.016)	0.009 (0.016)	0.011 (0.016)	0.012 (0.016)	0.011 (0.016)
college degree	-0.114*** (0.017)	-0.115*** (0.017)	-0.114*** (0.017)	-0.113*** (0.018)	-0.114*** (0.018)
age	0.004** (0.001)	0.004*** (0.001)	0.004*** (0.001)	0.004*** (0.001)	0.004*** (0.001)
race indicators	Yes	Yes	Yes	Yes	Yes
assignment controls	Yes	Yes	Yes	Yes	Yes
peer mean characteristics	No	Yes	Yes	Yes	Yes
location controls	No	No	Yes	Yes	Yes
battalion controls	No	No	No	Yes	Yes
sergeants CE rate	No	No	No	No	0.299*** (0.103)
Observations	10141	10141	10141	10141	10141

Standard errors are clustered at the company level in all regressions. Assignment controls include military occupation and year-month of initial assignment to the company. Peer mean characteristics are by company for junior enlisted and include aptitude, education, and age. Location and and battalion controls are fixed effects based on Army base and higher headquarters to which the company is assigned, respectively. Sergeants CE rate is the contemporary participation rate of the sergeants who are assigned to the company.
* p<0.10, ** p<0.05, *** p<0.01

Table 5: Incumbent Peer CE Use and New Soldier CE Participation

New soldier CE use by month 9 is a binary independent variable
Dependent variable is incumbent peer group CE rate 9 months after new soldier arrives

	(1)	(2)	(3)	(4)	(5)
new soldier CE use by month 9	0.029***	0.027***	0.014***	0.009***	0.008***
	(0.005)	(0.005)	(0.004)	(0.003)	(0.003)
AFQT	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
some college	-0.004	-0.004**	-0.003	-0.002	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
college degree	-0.001	-0.002	-0.002	-0.003	-0.003
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
age	-0.000	-0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
race indicators	Yes	Yes	Yes	Yes	Yes
assignment controls	Yes	Yes	Yes	Yes	Yes
peer mean characteristics	No	Yes	Yes	Yes	Yes
location controls	No	No	Yes	Yes	Yes
battalion controls	No	No	No	Yes	Yes
sergeants CE rate	No	No	No	No	0.123**
					(0.048)
Observations	10141	10141	10141	10141	10141

Standard errors are clustered at the company level in all regressions. Assignment controls include military occupation and year-month of initial assignment to the company. Peer mean characteristics are by company for junior enlisted and include aptitude, education, and age. Location and battalion controls are fixed effects based on Army base and higher headquarters to which the company is assigned, respectively. Sergeants CE rate is the contemporary participation rate of the sergeants who are assigned to the company.
* p<0.10, ** p<0.05, *** p<0.01

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Table A1: Summary Statistics for New Soldiers across Samples

These are newly assigned soldiers who spent at least 9 months in the company.
Non-sample soldiers are excluded from main analysis because of assignment to a brigade that had a combat deployment for some part of 2012-2013.

	sample soldiers			non-sample soldiers		
	n	Mean	SD	n	Mean	SD
AFQT	10141	57	18	41763	59	19
GED	10141	0.03	0.18	41763	0.04	0.20
high school graduate	10141	0.88	0.33	41763	0.86	0.35
some college	10141	0.05	0.23	41763	0.06	0.24
college graduate	10141	0.03	0.18	41763	0.04	0.19
age	10141	21	2.83	41763	22	2.95
white	10141	0.59	0.49	41763	0.65	0.48
black	10141	0.21	0.40	41763	0.16	0.37
Hispanic	10141	0.14	0.34	41763	0.13	0.34
other race	10141	0.07	0.25	41763	0.05	0.23
male	10141	0.92	0.28	41763	0.93	0.25
female	10141	0.08	0.28	41763	0.07	0.25
combat career field	10141	0.61	0.49	41763	0.62	0.48
logistics career field	10141	0.39	0.49	41763	0.38	0.48

Source: Office of Economic and Manpower Analysis.

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Table B1: New Soldier CE Participation and the Existing Company Human Capital Environment (Linear Specification, with Common Shocks Analysis)

Ex ante CE participation is measured by the percentage using CE in company
Binary dependent variable is new soldier CE use by month 9

	(1)	(2)	(3)	(4)	(5)
ex ante CE rate	1.022***	0.955***	0.350***	0.163*	0.132
(junior enlisted)	(0.074)	(0.069)	(0.131)	(0.084)	(0.091)
AFQT	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
some college	0.010	0.011	0.012	0.012	0.012
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
college degree	-0.115***	-0.112***	-0.110***	-0.109***	-0.108***
	(0.018)	(0.017)	(0.017)	(0.018)	(0.018)
age	0.004***	0.005***	0.005***	0.005***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
race indicators	YES	YES	YES	YES	YES
assignment controls	YES	YES	YES	YES	YES
peer mean chars	NO	YES	YES	YES	YES
location controls	NO	NO	YES	YES	YES
battalion controls	NO	NO	NO	YES	YES
sergeants CE rate	NO	NO	NO	NO	YES
Observations	10141	10141	10141	10141	10141

Standard errors are clustered at the company level in all regressions. Assignment controls include military occupation and year-month of initial assignment to the company. Peer mean characteristics are by company for junior enlisted and include aptitude, education, and age. Location and battalion controls are fixed effects based on Army base and higher headquarters to which the company is assigned, respectively. Sergeants CE rate is the contemporary participation rate of the sergeants who are assigned to the company.
* p<0.10, ** p<0.05, *** p<0.01

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Table C1: New Soldier CE Participation and Peer Mean Characteristics

This is reduced form estimation - equation (1.4) in the paper
Binary dependent variable is new soldier CE use by month 9

	(1)	(2)	(3)
AFQT	0.001**	0.001***	0.001***
	(0.000)	(0.000)	(0.000)
some college	0.010	0.011	0.011
	(0.016)	(0.016)	(0.016)
college degree	-0.114***	-0.113***	-0.113***
	(0.017)	(0.018)	(0.018)
age	0.004**	0.004***	0.004***
	(0.001)	(0.001)	(0.001)
race indicators	YES	YES	YES
assignment controls	YES	YES	YES
peer mean age	0.008	0.013*	0.013*
	(0.006)	(0.007)	(0.007)
other peer mean characteristics	YES	YES	YES
location controls	YES	YES	YES
battalion controls	NO	YES	YES
sergeants CE rate	NO	NO	YES
Observations	10141	10141	10141

Standard errors are clustered at the company level in all regressions. Assignment controls include military occupation and year-month of initial assignment to the company. Other peer mean characteristics are by company and include aptitude and education. Location controls and battalion controls are fixed effects based on Army base and higher headquarters to which the company is assigned, respectively. Sergeants CE rate is the contemporary participation rate of the sergeants who are assigned to the company.
* p<0.10, ** p<0.05, *** p<0.01

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