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Social Interactions and Obesity: An Economist's Perspective

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60.1 INTRODUCTION

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The importance of social ties as a force shaping human behavior has been recognized since ancient times, with references going back as early as Horace. It is only in recent decades, however, that researchers in the social sciences have begun to refine the concept of social interactions and distinguish between its various forms. Mathematical models are used to advance coherent thinking, and datasets on actual behavior are used to quantify the relationships of interest.

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Measurement of the impact of social interactions is complex, and often confounded by other factors that may lead to a correlation across individuals. This literature has also been limited because there are few data sources that contain information about peer networks.

Traditionally, policies for combating obesity are linked to factors like the nutritional composition of food in cafeterias at schools and at work, food prices, facilities for exercising, the proximity of schools to fast-food restaurants, etc. However, the dramatic increase in obesity in industrialized countries around the world – documented

p0030 in various chapters elsewhere in this volume – require researchers and policy-makers to think beyond standard policies. Some recent new policy initiatives attempt to use social forces to boost the effectiveness of existing policies. Examples include issuing weight report cards to school-children (with information on their weight and how it compares to the weight of their peers), and the use of role models in promoting healthy behaviors. Weight-reduction programs, such as WeightWatchers® and TOPS (Take Off Pounds Sensibly), have long used group meetings as part of their programs, with the idea that social support may facilitate weight reduction.

p0020 Social interactions in relation to obesity have been a focus of research in various disciplines (see, for example, Chapter 61). In this chapter, we look from an economist’s perspective at published contributions in the social interactions literature. As will become clear, economists’ contributions have largely focused on how to identify the various forms of social interactions from empirical data. We will also highlight the implications for studying and combating obesity by discussing a number of recent policy initiatives.

s0015 60.2 THE DIFFERENT GUISES OF SOCIAL INTERACTIONS

p0025 Researchers investigating the relationship between an individual’s weight and the weight of his or her peers must be aware of the many possible explanations for a correlation in weight across individuals. The identification of various sources of this correlation has played a central role in the economics of peer effects. Understanding the precise nature of the correlation between individuals and their peers is necessary to properly design policy interventions. The various causes of the correlation across

peers have been carefully discussed in the literature on identification of peer effects (see, for example, Manski, 1993; Moffitt, 2001).

Most researchers are interested in identifying direct effects: having obese or overweight peers causes an individual to be obese or overweight as well. These direct effects are typically referred to as *endogenous* social or peer effects in the economic literature, as defined by Manski (1993). These may also be called social network effects or induction. One explanation of why endogenous social effects regarding obesity may be observed could be that there are endogenous social effects related to exercise or dietary behavior, especially if peers eat or exercise together. The data sources used in this literature do not provide sufficient information to identify these effects separately, so they may be captured in the effects of BMI. Another explanation could be that people prefer to be like others, so if they observe that their peers are all of normal weight they will also prefer to be of normal weight. This idea has been discussed in several theoretical economic models – see, for example, Burke and Heiland (2007) and Etile (2007).¹ Endogenous social effects could have a powerful effect on obesity rates because they imply a social multiplier or process of mutual influence as described above. Manski (1993) highlights one of the key problems with measuring endogenous social effects, in that measurement is biased by the simultaneous relationship between peers: individuals affect their peers, and peers simultaneously affect the original individual. Manski has dubbed this “the reflection problem”.

While researchers are interested in identifying endogenous effects of social interactions, it is possible that other factors lead individuals to be similar to their peers. The first possibility is that individuals are affected by the *background* characteristics of their peers; this is often referred to as a contextual effect. For example, the BMI of

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¹It is also possible that there is actually a contagious effect; Turnbaugh and colleagues (2006) show that certain infections can increase the likelihood of weight gain.

one person could be affected directly by a peer's knowledge of healthy behaviors, irrespective of any effect of the peer's BMI. Second, individuals and their peers share a common environment, and this common environment may lead to a positive correlation between their behaviors. The effects of a common environment are referred to as correlated effects. For example, students at the same school may have access to the same food options in their cafeteria, or similar requirements to participate in physical education. Also, individuals and their peers may share characteristics that cause them both independently to gain weight. One example of this is shared genetic characteristics of siblings, which could cause them both to gain weight regardless of their interactions. Finally, there may be a problem of selection (or homophily) where people with similar tastes and attitudes are more likely to be peers. If researchers do not adequately control for these factors, estimates of endogenous social effects will be biased.

background, and were exposed to the same food habits and lifestyle while growing up; these joint influences are represented by the "family" parameter α_F . The variable x_{Cindy} is an exogenous characteristic that applies to Cindy. For example, x_{Cindy} could be a dummy variable which is 1 if Cindy's employer promotes a program for exercising during lunch breaks at work.

If $\alpha_2 > 0$, then there is a direct relationship between Cindy and Daisy's BMI; if one gains weight, the other gains weight.² This could represent a competition between the sisters, a desire to be similar, or changes in their perceptions of the ideal weight. If $\alpha_3 \neq 0$, the exercising program at Cindy's work also has a direct effect on Daisy's BMI (a contextual effect). This could represent the effect of information; Daisy learns from Cindy about the existence of such a program, which might trigger a behavioral response from Daisy, independent of the effect the program might have on Cindy's BMI. ε_{Cindy} and ε_{Daisy} represent all other factors that affect BMI, but that are unobserved to researchers.³

To illustrate these complexities, consider the following example. Two sisters, Cindy (32) and Daisy (33), live in different cities. They (physically) meet at least once a year to engage in some joint activity, like shopping, hiking, or just sitting together in a restaurant. The interrelationships between Cindy's and Daisy's BMIs might be mathematically represented as follows:

$$BMI_{Cindy} = \alpha_F + \alpha_1 x_{Cindy} + \alpha_2 BMI_{Daisy} + \alpha_3 x_{Daisy} + \varepsilon_{Cindy} \quad (60.1)$$

$$BMI_{Daisy} = \alpha_F + \alpha_1 x_{Daisy} + \alpha_2 BMI_{Cindy} + \alpha_3 x_{Cindy} + \varepsilon_{Daisy} \quad (60.2)$$

Here, BMI_{Cindy} represents Cindy's Body Mass Index (all variables for Daisy are defined analogously). Cindy and Daisy have a joint genetic

How important is the distinction between direct and indirect effects? To answer this question, we consider a simple numerical example with $x_{Cindy} = 1$, and $x_{Daisy} = 0$; Cindy's employer has implemented a lunch-break exercising program, but Daisy's employer has not. First, consider the case with $\alpha_1 = -1$, $\alpha_2 = 0$ and $\alpha_3 = 0$. These parameter values imply that the lunch-break exercising program results in a decrease in Cindy's BMI by 1 full point, while leaving Daisy's BMI unchanged. Now consider the case where $\alpha_2 = 0.5$ (with the values for the other parameters unchanged). This means that when Daisy observes that Cindy's BMI has dropped (for whatever reason), this will cause a drop in Daisy's BMI. This drop will be half as large as the (initial) drop in Cindy's BMI. This

²It is of course also possible that $\alpha_2 < 0$, but this seems less likely given the empirical research that has already been done in this area.

³In the simplest case, it is assumed assume that ε_{Cindy} and ε_{Daisy} are independent (orthogonal) to both x_{Cindy} and x_{Daisy} .

2. FROM SOCIETY TO BEHAVIOR: POLICY AND ACTION

s0020 follows from Equation (60.2). The causation could work through social mechanisms like imitation, encouragement and competition, along with a change in the perceived ideal weight.

p0070 Recall that α_2 does not represent an informational effect, which would work through α_3 . Conversely, the resulting drop in Daisy's BMI will be observed by Cindy, which will cause a further drop in Cindy's weight. This follows from Equation (60.1). This process of mutual influence will continue and converge to an equilibrium where Cindy's BMI has decreased by 1.333 points ($=1 + 1/4 + 1/16 + \dots$) and Daisy's BMI has decreased by 0.667 points ($=1/2 + 1/8 + 1/32 + \dots$). Note that with social interactions, the total effect of Cindy's lunch-break exercise program is twice as large as $(1.333 + 0.667)$ as without social interactions $(1 + 0)$.

p0060 Thus, in the presence of social interactions, changes in the behavior (BMI) of one person in the social group are typically magnified as a result of a "social multiplier". Clearly, the social multiplier not only has the potential to make health interventions more effective; it can also exacerbate health problems in a social group.

p0065 Note that the same total effect on BMI would result if the parameter values were $\alpha_1 = -1.333$, $\alpha_3 = -0.667$ and $\alpha_2 = 0$ – that is, a case without endogenous peer effects. This illustrates the difficulty of telling from empirical data to what extent the effects are the result of direct or indirect social interactions. Yet the distinction is important for policy design. In the former case it could make sense to use social mechanisms to promote healthy behaviors; in the latter case does not.

60.2.1 Separating the sources of correlation across peers in empirical research

Suppose that we have a large sample available of sister pairs like Cindy and Daisy. Even if there were no social interactions at all ($\alpha_2 = 0$ and $\alpha_3 = 0$), we would find a correlation between sisters' BMI because of their similar genetic, parental and family backgrounds (through parameter α_F). As highlighted by Manski (1993), Moffitt (2001) and others, it is usually impossible to identify all parameters in Equations (60.1) and (60.2) without further assumptions. One such assumption is $\alpha_3 = 0$ (absence of "contextual effects"). In our example, this means that we would assume that the lunchtime exercising program of Cindy's employer does not have a *direct* effect on Daisy's BMI. If we were to find an effect of Cindy's lunchtime exercising program on Daisy's BMI, the implication – with the assumption $\alpha_3 = 0$ – would necessarily be that this was the result of an indirect effect. Cindy's lunch exercise program has an effect on Cindy's BMI, and Cindy's BMI has a causal effect on Daisy's BMI.⁴ Data that involve random variations in peer groups (Sacerdote, 2001) or random treatment of a part of a peer group (Kuhn *et al.*, 2008) offer improved prospects for identification.

Another important issue in the analysis of social interactions is the composition and formation of social groups (reference groups, peer groups). In general, the larger the disparity in people's behavior, the less likely it is that they will belong to the same social group. The mere fact that the BMI of two individuals is very different could be a reason in itself for not counting

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⁴Standard econometric theory implies that applying OLS to (1) and (2) is meaningless as it leads to a simultaneity bias. One solution is to estimate the so-called reduced form, which entails regressing BMI on a constant and x_{Daisy} and x_{Cindy} . However, this yields only three estimated regression coefficients which are insufficient to separately identify the four structural parameters α_F , α_1 , α_2 and α_3 . If, in our example, we find in the reduced form regression that the lunch exercising program of one sister affects the BMI of the other, we know that there is some form of social interaction. However, we do not know which type it is, without further assumptions.

one another as friends. The selection of peers makes especially difficult the interpretation of research that analyzes social interactions between self-reported friends. An example is research based on the National Longitudinal Adolescent Health Survey (Add Health), in which respondents are asked to nominate five female and five male friends.

and Fowler's research for this reason, and performed additional analyses using the National Longitudinal Adolescent Health Survey (Add Health). Their general finding is that social interactions are not significant once fixed effects for social groups or individuals are accounted for. This is essentially a statistical tool for controlling for the joint effects represented by α_F in Equations (60.1) and (60.2). Fowler and Christakis (2008) responded by adding fixed effects to the model reported in Christakis and Fowler (2007), and still found statistically significant effects. There are three reasons for the differences across the two papers. First, Cohen-Cole and Fletcher showed that the results are sensitive with respect to the specification of the dependent variable (for example, using a dummy variable indicating overweight (BMI > 25) versus using the continuous measure of BMI). In particular, the precise distribution of the population's BMI distribution relative to the cutoffs for overweight and obesity is important. Second, it is possible that the endogenous social effects regarding obesity are different among adults and adolescents.

The third difference derives from how each paper deals with common environmental factors. Christakis and Fowler (2007) address this issue by comparing the results across different types of peers. For example, when both the individual and the peer report a relationship, there is a positive and significant correlation, but when only the peer reports a relationship there is no significant effect. Cohen-Cole and Fletcher (2008) use school fixed effects to deal with the common environment faced by students in the same school, and this causes the significant effects on peer BMI to disappear. In a related paper, Cohen-Cole and Fletcher (2010) show that implausible social network effects (for example, related to height) can be found if joint factors are not controlled for. Typically, the fixed-effect approach is preferred by economists.

Trogon and colleagues (2008) focus on the reflection problem in a study of peer effects in

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60.3 THE LITERATURE SO FAR

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A growing but still limited number of empirical studies have analyzed social interactions in obesity. No doubt the most influential paper so far is that by Christakis and Fowler (2007), which was featured on the front pages of newspapers and news websites around the world. Christakis and Fowler analyzed a social network of 12,000 people whose weight was measured every 4 years during a 32-year period. Their statistical model analyzed the association in weight gains between friends, siblings, spouses and neighbors (not between co-workers). They report that a person's chance of becoming obese increased by 57 percent if he or she had a friend who became obese in a given interval; among pairs of adult siblings, if a sibling became obese, the probability that the other would become obese as well increased by 40 percent; if one spouse became obese, the chance that the other spouse would become obese increased by 37 percent; and no significant effects were found for interactions between neighbors. Interactions between people of the same sex were generally found to be stronger than between people of opposite sex – a result also reported by Soetevent and Kooreman (2007) for various behaviors in adolescents.

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Although Christakis and Fowler note that their results may not merely represent endogenous social interactions ($\alpha_2 \neq 0$ in our notation), their original article strongly suggests that they can be interpreted as such. Cohen-Cole and Fletcher (2008) have criticized Christakis

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adolescents' BMI. They also use the Add Health data. The central explanatory variable in their model is the average BMI of self-reported friends, similar to Equations (60.1) and (60.2). They attempt to control for the selection of friends' BMI by using obesity of friends' parents, and friends' birth weight, as instrumental variables. This amounts to assuming that obesity of friends' parents and friends' birth weight do not have a direct effect on a given student's BMI ($\alpha_3 = 0$ in our notation). With this identifying assumption, the coefficient of friends' average BMI is about 0.50. Using quantile regression, they find that peer effects are larger for individuals at the higher end of the BMI distribution, especially for girls. However, in an alternative specification in which the authors use all grade-level students in a school as peer group (rather than the self-reported friends), the peer effects are smaller, and – when performed separately by gender – peer effects are not significant for males. This points at a friend-selection effect driving the former results (and casts doubt on the appropriateness of the instrumental variables).

While all of these papers have made attempts to address the complexities of social interactions, their primary drawback is that they rely on the nomination of one's closest peers. With self-nominated peers, researchers have the advantage of focusing on the people that a person considers to be the most important in their network of friends, but this is always subject to the problem of selection: who one chooses to be friends with. Ideally, research on endogenous social effects using self-nominated peers would carefully consider the endogeneity of the peer connections themselves. As mentioned, Trogdon and colleagues (2008) try to address this by looking at peer effects within an entire grade in the school. However, research on peer effects

in education finds that within-classroom effects are much more important than within-grade effects.⁵ If peer groups are defined too broadly, researchers run the risk of failing to measure an effect when one actually exists.

Another problem is that self-reported peer groups are usually assumed to remain unchanged. For example, Fowler and Christakis (2008) consider only those peers in the Add Health data who remain friends over time. This does not take into account the fact that people may stop being friends because of changes in weight. Cohen-Cole and Fletcher (2008) focus only on friendships that existed in the first wave of data. This will bias results, because some “peers” will in fact no longer be peers.

60.4 POLICY INTERVENTIONS RELATED TO SOCIAL INTERACTIONS

A number of policies have been proposed and implemented that attempt to take advantage of social interactions in obesity-related behavior. First, we discuss policies designed around schools and workplaces where entire social groups are affected by the same policy. By bringing attention to the issue in a group setting, they may help to motivate people to lose weight. Second, we consider programs that explicitly use a group setting to help individuals lose weight. As mentioned by Christakis and Fowler, weight-loss support groups have been in place for a many years (Christakis and Fowler, 2007; Fowler and Christakis, 2008). For example, TOPS, a network of such groups, has been operating for 60 years.

⁵Examples of papers that measure peer effects at the classroom level include Hoxby and Weingarth (2005), Cooley (2007), and Carman and Zhang (2008). Examples of paper that measure peer effects at the grade level include Hanushek *et al.* (2003), and Hoxby (2000).

s0045 **60.4.1 “Obesity reports” in Arkansas**

p0130 In 2006, the State of Arkansas supplemented children’s school reports with an “obesity report”, indicating – by means of a percentile – the child’s position in the weight distribution of same-age children in school. For example, the report mentioned that the child’s BMI was in the 80th percentile. Similar initiatives have been developed in Delaware, South Carolina, Tennessee, Pennsylvania and New York.

p0120 The weight report cards have been reported to stigmatize children, which can have negative effects on their emotional wellbeing. While regrettable, stigmatization is one possible channel of endogenous social effects. Also, these reports are sometimes inconsistent with other policies in school, such as unhealthy food in the school’s cafeteria or limited opportunities for physical education. The scientific basis for mandating this policy seems to be lacking, given the absence of randomized trials to evaluate its effectiveness.

s0040 **60.4.2 Role models**

p0125 In the realm of endogenous social effects, it is possible that some individuals have a larger impact than others. Certain individuals may act as role models for their peers, and thus their weight gain or loss may have a larger social impact. For example, ACTION! Wellness Program for Elementary School Personnel was designed with this in mind.⁶ The program targets employees in elementary schools in part because of the influence that they may have as role models for the children attending the school. Most research on endogenous social effects has treated all peers as equal, but models could be adapted to allow for the possibility that some peers matter more than others.

⁶The program is summarized in Pratt *et al.* (2007) and Webber *et al.* (2007).

⁷Pratt and colleagues (2007).

⁸See, for example, Duflo and Saez (2003) and Carman (2006).

60.4.3 Workplace programs

Employers are increasingly interested in improving the health of their employees to improve the productivity of their workforce and reduce the costs of health care. Many of their programs exploit social networks. Encouraging exercise breaks, providing access to on-site gyms, or even a recent program in Japan to make employers responsible for their employees’ weight all bring weight-reduction programs into a context where people know each other. The large interest in this area is illustrated by an entire issue of the journal *Obesity* devoted to the evaluation of workplace interventions.⁷ While rarely the central issue of study, these programs all exploit the fact that group members can motivate and support each other, especially with interventions like facilitation of exercise groups and pedometer challenges. Previous research has found evidence of endogenous social effects in the workforce, although in other contexts.⁸ However, again, workplace policies aimed at reducing obesity have not been evaluated in terms of endogenous social effects.

Most studies of the effectiveness of workplace programs randomize treatment at the level of the worksite. Thus, either all employees in a particular location are treated or all are untreated. A randomized trial that treated only some employees within a worksite could be used to track endogenous social effects.

60.4.4 Weight-loss support groups

Weight-loss support groups are an important part of many commercial weight-loss programs. These groups are explicitly designed to use social support to help individuals lose weight. It is believed that social influences from other individuals trying to lose weight will aid

60.5 CONCLUSIONS

s0055 in weight reduction. This strategy has been popular in groups dealing with addictions, such as Alcoholics Anonymous.

p0160 While many different organizations make use of these programs, the effectiveness of weight-loss support groups independent of the other aspects of these programs has not been carefully studied. Tsai and Wadden (2005) reviewed the literature on commercial weight-loss programs (many of which use support groups) and reported that most studies of commercial weight-loss programs find no significant benefits. Perri and colleagues (1987) found that peer support groups have no significant effect on weight-loss. In contrast, Song and colleagues (2008) and Orth and colleagues (2008) found that support-group attendance is associated with increased weight loss for people who have undergone bariatric surgery. However, their results may be due to selection bias; those who choose to attend groups may be different from those who do not attend groups, and people who have chosen to undergo bariatric surgery are likely very different from those who have not followed this path. Despite the fact that there is little evidence of the effectiveness of support groups, they continue to be a prominent part of the weight-loss landscape.

p0150 Recently, Internet weight-loss support groups have started to gain popularity. Long-term provision of and participation in traditional support groups is costly for both the provider and the participant. Internet support groups, on the other hand, have the potential to provide long-term support in a cost effective way. However, several studies by Harvey-Berino and colleagues (2002a, 2002b, 2004) have evaluated participation in Internet support groups and found no significant effect.

p0155 While actual participation in support groups by individuals interested in losing weight indicates a revealed preference for this type of weight-loss program, there is no evidence that they actually aid in the weight loss through peer effects.

The empirical literature makes clear that social influences can be an important channel to affect weight-related behavior and boost the effectiveness of more traditional policies. The literature also makes clear, however, that the magnitude of these effects is generally modest once confounding factors – in particular the similarity of the backgrounds of people in a peer group – are accounted for.

Several policies have been proposed and implemented that attempt to take advantage of social mechanisms in shaping health-related behaviors. None of them, however, seems to have been accompanied by careful scientific investigation of their effectiveness. A prerequisite for developing successful future policies in this domain is pre-testing their effectiveness, preferably through randomized trials.

There are several open questions in the literature to be addressed in future research. One is whether a change in a peer's BMI has a temporary or more permanent effect on an individual's BMI. Another is whether peer effects are symmetric for weight loss and weight gain. Answering such questions requires high-frequency longitudinal data on the same individuals, with objective rather than self-reported weight measurements, and models that control for panel attrition and changes in peer groups.

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2. FROM SOCIETY TO BEHAVIOR: POLICY AND ACTION

