Understanding Intent-to-Treat, Treatment-on-the-Treated and Program Effects

Imagine the following, admittedly silly, study.

A researcher wants to look at how much money people receive if you give them money. The answer is pretty obvious – they receive whatever you give them. But this researcher isn't very smart.

He gives 100 randomly chosen people (the experimental group) a present of $100. He gives another 100 randomly chosen people (the control group) nothing.

The following day he surveys the sample and asks how much money they received. All the workers in the experimental group report that they received $100 and all those in the control group report $0. The average difference between the two groups is $100. This is the intent-to-treat (ITT) estimate. Everyone whom the researcher wanted to give $100, received $100 and no one in the control group did. Because everyone who was intended to be treated actually received the $100 and noone in the control group was treated, the ITT estimate is also the treatment-on-the-treated (TOT). Everyone who was given $100 received $100.

Elated by this discovery, the researcher tries a new study. He tells the experimental group that if they come to his office, they will receive $100. He tells the control group nothing. Some of the experimental group do not bother showing up to collect the $100, perhaps because they do not believe the researcher or think it is too much work. Let's suppose that 80% show up. The next day the researcher again conducts a survey in which he asks whether people went to his office and how much money they received. This time he finds that, on average, the experimental group received $80 (80% x $100) compared to the control group's $0. The ITT estimate is $80 – the people to whom he intended to give $100 received an average of $80 more than did the people he did not intend to treat. But, of course, the people who actually showed up got $100 each. This is the TOT and can be calculated as $80/.80 – the ITT divided by the difference in the proportion treated.

Finally, the researcher decides to vary the amount people receive. He tells 25 experimental group members that they will receive $25, 25 that they will receive $50, 25 that they will receive $75 and 25 that they will receive $100. Again the controls are not told to collect money. And this time he is careful not to give any money to the controls. This time 30% of the experimental group show up to collect the money. When they are surveyed the next day, the average member of the experimental group turns out to have received $21, and, of course, all members of the control group received $0. The ITT is $21. We no longer have an easy way to figure out the TOT. If everyone in the experimental group had collected their money, the TOT would have been $62.50 (the average of $25, $50, $75 and $100), but we would not be surprised if people who knew they were going to be given more money were more likely to collect the money. However, we can figure out the TOT by using the formula: TOT = ITT/(difference in percentage treated). In this case we have $21/.3 = $70. The average person who picked up the money received $70.

Unfortunately, this approach does not always work although it will generally give us some of the information we are looking for because it produces the "average treatment effect on compliers." Compliers are the people who get the money if and only if they are put into the treatment group. Suppose there are two programs giving out money. The other program gives out $200, and it is impossible to collect money from both since they both require participants to show up at midnight to receive the money. Unfortunately for the researcher, 25 people in his control group and 25 people in his experimental group are eligible for the other program. Naturally, they prefer $200 to $100. And 25 people in the experimental group cannot be bothered to pick up $100 at midnight. As a result, when the experimenter surveys people the next day, he discovers that in his experimental group, 25% received $200, 50% received $100 and 25% received nothing, for an average of $100. In the control group, 25% received $200 and 75% received nothing, for an average of $50. The difference in the average is therefore $50. The difference in participation (in a program giving out money) is .75-.25=.5. Since $50/.5=$100 we get the effect of the program on those who were offered and accepted participation (compliers). The effect of participating in any program is greater than $100 since some participants receive $100 and others receive $200.