

Understanding Variations in Group Differences That are the Results of Changes in the Prevalence of an Outcome

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I will be explaining a fundamental but generally overlooked statistical tendency and addressing two implications of that tendency in the health research area. The tendency, which for shorthand I'll refer to as Interpretive Rule 1 (IR1), is the following:

[SLIDE 2 – IR1]¹

When two groups differ in their susceptibility to an outcome, the rarer an outcome, the greater the relative difference in experiencing it and the smaller the relative difference in avoiding it.

[SLIDE 3 - Implications]

The first implication of IR1 involves the interpretation of research into health disparities. In brief, for decades researchers here and abroad have been finding that, during periods of declining mortality, health inequalities – measured in terms of relative mortality rates – have been increasing. Such research, however, is suspect for failure to recognize that, as an outcome declines in prevalence, relative differences in experiencing it tend to increase while relative differences in avoiding it tend to decline.

The second implication of IR1 involves the interpretation of differential effects of ameliorating and exacerbating factors on rates at which two groups experience some

¹ To be used with PowerPoint Presentation found at:
http://www.jpscanlan.com/images/APHA_Presentation.ppt Abstract is at:
http://www.jpscanlan.com/images/APHA_Abstract.pdf.

outcome. Again in brief, when two groups differ in their baseline rates of experiencing some outcome, such factors will tend almost invariably to have differential effects regardless of any actual difference in the way the factor affects outcomes of individuals in the two groups.

The patterns whereby the rarer an outcome, the greater the disparity in experiencing and the smaller the disparity in avoiding – or IR1 – can be illustrated with virtually any data that allows one to examine the rates at which two groups fall above or below any point on a continuum of factors associated with experiencing or avoiding some outcome. I will illustrate these patterns with actual income data.

But one should expect to find these patterns wherever two groups have different risk distributions with respect to experiencing or avoiding some outcome.

This is not an easy to subject to explain orally. So to the extent I leave you puzzled or unpersuaded, I refer you to the following references, which are available on my website – jpscanlan.com.

[SLIDE 4 – References]

Listed are articles from *Chance* and *Society* magazines and recent papers from conferences in the UK and Denmark. They are easy to find on the web site.

Here, I'll simply say of the first article – “Can We Actually Measure Health Inequalities?” – that at least as to mortality, I believe the answer is no. At any rate I don't know how it can be effectively done. The paper on health inequalities in the UK suggests some possibilities for measuring changes in inequalities in some other aspects of health.

[SLIDE 5 – Table 1]

To illustrate IR1, I begin with a relatively simple table that reflects what we may call the heart of the matter. The first data row, in Column b, shows the black proportion of the combined black and white population falling below the poverty line. The second data row in the same column shows the black proportion of that population falling below 75 percent of the poverty line. The first figure is 26 percent and the second is larger (28 percent). Column c then shows the ratio of the black rate to the white rate of falling below each point. That figure is 2.3 for the poverty line itself and 2.5 for 75 percent of the poverty line. That these ratios increase is simply a corollary to the fact that blacks comprise a larger proportion of the population below 75 percent of the poverty line they do of the population below the poverty line itself.

Now consider what would happen if poverty were to decline such that everyone between the poverty line and 75 percent of the poverty line were enabled to escape poverty. Typically, we would regard such a reduction as especially beneficial to blacks since they are more likely to be poor than whites. But as a result of the decline in poverty the proportion blacks comprise of the poor would increase from 26 to 28 percent and the ratio of black poverty rate to the white poverty rate would rise from 2.3 to 2.5

Understanding this pattern is crucial to appreciating why improvements in health – or in any other aspect of human well-being – will tend almost invariably to increase racial and other disparities in experiencing adverse outcomes. For progress in almost every area of human well-being is usually a matter of serially restricting adverse outcomes to the points where only the most susceptible segments of the overall population continue to experience them. That tends to increase the disparity in rates of continuing to experience the adverse outcome.

[SLIDE 6 – Figure 1]

This pattern exists across the distribution. Figure 1 shows the ratio of the black-to-white rates of falling below each of 12 points defined by percentages of the poverty line. The points range from 600 percent to 50 percent – that is, from being relatively well off to being extremely poor. And we observe – moving from left to right – that throughout the range, the lower the income the greater is the relative black/white difference in rates of falling below that point.

I have elsewhere illustrated this pattern with hypothetical test score data. Where two groups differ in their average test score, lowering a cutoff increasingly concentrates test failure among the lowest scorers on the test, and hence increases disparities in failure rates. But you would observe the same pattern if instead of lowering the cutoff, we were able to improve test performance such that everyone scoring just below the cutoff was enabled to reach the cutoff.

The same holds with regard to mortality and other adverse health outcomes. When the prevalence of the outcome is reduced, it becomes further concentrated among the most susceptible segments of the population. And the closer we come to eliminating an adverse outcome entirely, the greater will tend to be the disparity in rates of continuing to experience the outcome.

[SLIDE 8 – Figure 2]

Now let us examine the other side of the picture – the relative difference in experiencing the favorable outcome. Figure 2 shows the ratio of the rate at which whites fall above each income level to the rate at which blacks fall above that level. That ratio declines – i.e., the difference grows smaller – as we move from left to right. Thus, we

observe that the size of relative differences in experiencing an outcome and in avoiding the outcome tend to move systematically in opposite directions as the prevalence of the outcome changes. You would see the same pattern in test score data. Lowering a cutoff, while increasing the disparity in failure rates, would reduce the disparity in pass rates.

That disparities in adverse and favorable outcomes tend to move systematically in opposite directions has an important implication with respect to the evaluation of changes in the size of disparities. Some might be inclined to maintain that an increase in the difference between rates of experiencing an adverse outcome reflects some true worsening of the relative status of the disadvantaged group, even when the increase results solely from a general decline in the prevalence of the outcome. In any case, one would have to regard such a change as a much different occurrence – and a far less consequential occurrence – than a change that went beyond the usual consequences of the overall decline in the outcome. But it becomes difficult to maintain that an increase in the relative difference in adverse outcomes that flows solely from a decrease in prevalence somehow reflects a true worsening of the relative situation of the disadvantaged group when one recognizes that, if one appraises the matter in terms of the favorable outcome, one has to conclude that the disparity has declined.

As it happens, relative differences in many indicators have traditionally been measured in terms of the favorable outcome. Because the lowering of cutoffs tends to reduce relative differences in pass rates, the lowering of cutoffs has been universally regarded as reducing the disproportionate impact of such tests on minorities or women, even though lowering cutoffs increases disparities in failure rates. Disparities in beneficial health procedures (e.g., prenatal care, immunization, and mammography) have

traditionally been evaluated in terms of differences in rates of receiving the procedure. Thus, the increased availability of such procedures has led to a perception that inequalities are declining, even as that same increased availability, by reducing certain types of mortality, has led to the perception that racial differences in those types of mortality are increasing.

In any case, while it seems that hundreds of millions of dollars may be spent each year in the US and abroad studying health inequalities, essentially all of the research is open to questions for failure to appreciate IR1.

[SLIDE 10 – Health Disparities Implications of IR1]

The next slide lists some implications of IR1 in the health disparities context in a little more detail than presented at the outset. First, the universal consensus is that disparities in mortality have been increasing during times of declining mortality. But no one has really studied whether these changes are anything other than the usual consequences of declining mortality. As I indicate in the *Chance* magazine article I mentioned earlier, I am not sure it can be done – that is, I am not sure we can sort out the changes in the differences between two groups concerning some outcome from those changes that are solely a consequence of changes in prevalence.

Second, many patterns concerning the sizes of disparities in different settings have been studied and discussed. These include, for example, the larger disparities among the young than the old, large racial disparities in infant mortality where parents are well-educated, larger SES disparities among British civil servants than in the UK at large, and unusually large SES mortality disparities in egalitarian countries like Norway and Sweden. What has gone unnoticed is that the mortality disparities tend to be large

among certain groups simply because mortality is low among such groups. I go into many of these issues in the referenced paper for the British Society for Population Studies [SLIDE 11 – Differential Effects Implications of IR1]

Now consider what I term the differential effects implications of IR 1. Consider what would happen if we gave \$1000 to every black and white family. Figures 1 and 2 tell us that that would reduce poverty more among whites than blacks but would increase rates of avoiding poverty more among blacks than whites. The same would hold if we added ten points to the scores of all test takers – that is, it would reduce test failure more among the higher-scoring group but increase test passage more among the lower-scoring group. And of course the opposite would occur if we instead took away \$1000 or ten points on the test.

So now consider our efforts to study differential effects of factors that affect health. First, exacerbating factors (e.g., obesity, smoking, etc.) would be expected to increase adverse outcomes more among the least susceptible groups (e.g., whites, women, the young, non-smokers), but reduce favorable outcomes more among the most susceptible groups. That in fact is pretty much what we do observe in studies.

Second, beneficial interventions would be expected to reduce adverse outcomes more among the least susceptible groups, but increase favorable outcomes more among the more susceptible groups. I can't by any means summarize what the studies do show. But these issues are studied more and more often. And in order to study these issues in a way that would allow useful interpretation of the results, we have to endeavor to sort out patterns that are meaningful from those that are simply statistical. That is no easy task.

But we will make little progress without understanding the purely statistical aspects of the matter.