The Troublesome Toilet Seat: Up or Down? Three Schemes *

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1 Introduction

> In spite of Faye's repeated insistence that Mike leave the toilet seat down, Mike made the unfortunate mistake of accidentally leaving it up one day, only to suffer its dire consequences. Faye threw such a fit that Mike had to sleep on the couch almost that whole week until he made it up to her.

Most of us who read the above passage are probably sympathetic toward Mike, but strangely, not as harsh in our judgment of Faye as we should be. Consider instead the following situation:

> In spite of Mary's repeated insistence that Peter bring her a bunch of red roses every day on his way home from work, Peter made the unfortunate mistake of forgetting to do so one day, only to suffer its dire consequences. Mary threw such a fit that Peter had to sleep on the couch almost that whole week, until he made it up to her.

In this case, not only are we more sympathetic towards Peter than Mike, but we also judge Mary more harshly than Faye. The root of this disparity in our judgment is this: We are more likely to see Mike's act of lowering the toilet seat after use as an obligation on his part than Peter's act of bringing home a bunch of flowers to Mary. Surprisingly, to most of us, or at any rate many women it seems, the former action is an obligation, while the latter is an act of kindness. We rightly feel indignation when a party fails to deliver on its obligation, but

*Why would someone start a serious study of something so silly? That's precisely what I thought until I noticed that this seems to be a real problem in many households, at least as evidenced by popular sitcoms on TV such as ABC's "Home improvement" and NBC's "3rd rock from the Sun". This is what ultimately stimulated my academic interest in this seemingly trivial issue.

not when it misses a chance to perform an act of kindness. Thus while we are more likely to decide that poor Mike deserves his unfortunate fate, we suspect that there is some other serious problem in the relationship between Peter and Mary which caused Mary to erupt violently as she did.

Is leaving the toilet seat down after use an obligation or an act of kindness on the part of men? To most reasonable people, it isn't at all obvious why men might be obligated to leave the toilet seat down for women. For my part, I would be inclined to see it as an act of kindness more than anything else. I fail to see a single reason why it should be construed as an obligation unless maybe one could somehow prove that the sight of a raised toilet seat upsets the aesthetic equilibrium around it. But I'm sure one could come up with convincing arguments against this justification. Besides, I strongly suspect that this is not the reasoning behind most women's insistence that seats be left down. Let me even hazard a guess and say that the motivation has more to do with convenience than with aesthetics.

Well, where does this added convenience for women not having to lower the seat before use come from? Obviously, it can't come out of nowhere. A little thought shows that it actually comes from the added inconvenience of men having to lower the seat after use. In other words, it comes from the effort that men put in out of kindness to their partners. However, being kind is not the same as being efficient. Often times, it in fact translates directly into being grossly inefficient besides being unfair. And from this point of view, there are very strong arguments indeed, that men should definitely not leave toilet seats down after use. To see what I mean, we must look at this situation in an objective way.

2 Two Objective Proposals

So lets now be scientific about the whole issue. Which is better? I mean, better for the whole system: The man, woman and the toilet – all together. Is it possible to find an answer to this question? Well that's precisely what I'm going to do here. For the sake of convenience we will initially assume that the whole system consists of one man, one woman and one toilet. The best case is described as the situation in which the sum total of work done by all the parties is kept to a minimum, which also happens to be the situation in which the seat hinge suffers the least wear. The worst case is the opposite – when the system ends up doing maximum work and the seat hinge suffers most wear.

Now consider the two possible extreme solutions. In Scheme 1, the man raises the seat before using the toilet, and lowers it back when he is done. In this case, the woman does no work at all. In Scheme 2, the man raises the seat before using the toilet *if it isn't raised already* and the woman lowers it *if it isn't lowered already*. Neither changes the seat position after using the toilet.

As we shall see, Scheme 2 is by far the best one for the system. In all other schemes, including Scheme 1 which is in fact the worst, the system will end up doing more work. To see why, consider this: In Scheme 1, the man always raises

the seat before using the toilet and lowers it afterwards. So we count two units of work every time a man visits the toilet and none at all when a woman visits it. So the total amount of work the system does is twice the number of times the man visits the toilet. This number doesn't change regardless of how often the woman visits the toilet or how they interleave their visits.

In contrast, with Scheme 2, we need only count one unit of work each time the sex of the toilet visitor is different from that of its immediately previous visitor. The worst case scenario with this scheme is if the toilet visitors strictly alternate their visits to the toilet, i.e. every male visit is followed only by a female visit and vice-versa. In this case only, the work done by the system is roughly equal to that under Scheme 1. However, the advantage is that while this amount of work is fixed in Scheme 1 regardless of how the man and the woman interleave their visits, it can only get better and better in Scheme 2.

Let's look at a concrete example. Suppose that Mike and Faye visit the toilet 5 times each on a particular day. With Scheme 1, the total work done is 10 units regardless of the order in which they visit the toilet (Mike raises and lowers the seat each visit, and Faye does nothing). With Scheme 2 also, the total work done is 10 units, but only in the worst case where Mike and Faye strictly interleave their visits, i.e. as "MFMFMFMFMF". For all other orderings, one can prove using rather simple mathematics that the total work done is bound to be less than this. Try the ordering "MMMFFFMFMF", for instance. You will find the total work done is only 6 units. And in the case of "MMMMMFFFFF", the work done is only 2 units! Besides, not only is Scheme 2 more efficient, it is also the fairer of the two because work is more or less equally apportioned between the two sexes.

3 A Computer Simulation

I ran a computer simulation of the situation for a million toilet visits, with the sex of the visitor chosen randomly each time. I found that with Scheme 1, the total work done by the system was 999,386 units, while the total work done with Scheme 2 was only 499,270 units, which is less than half the work done under Scheme 1. Now, I had made the following two simplifying assumptions in running this simulation:

1. The average frequency of toilet usage was the same for both men and women and there was exactly 1 man and 1 woman in the house.

2. The amount of work done in raising the toilet seat is the same as that in lowering it.

What happens under slightly different circumstances? What about when there are more men in the house than women? How about 2 men and 1 woman? In this case, the numbers work out to 1,333,670 units of work under Scheme 1 and 444,225 under Scheme 2, less than a third of the work under Scheme 1. What if there were two women and one man? Under Scheme 1, 667,996 units

Distribution	Work (Scheme 1)	Work (Scheme 2)
1M + 1F	999,386	499,270
2M + 1F	1,333,670	444,225
10M + 1F	1,817,598	165,789
1M + 2F	667,996	444,515
1M + 10F	182,142	165,530
1M + 1000F	2,004	2,004
1M + 1F + 2T	999,386	1

Table 1: Summary of findings through computer simulation. Distribution represents the number of males (M) and number of females (F) in the household. Columns 2 and 3 represent the number of units of work done under Schemes 1 and 2 for a million toilet visits. The last row represents the ridiculous case when there are two toilets and Scheme 1 still requires the male to raise and lower the seat of his toilet each time, whereas in Scheme 2 he is required to do this at most once as the female will leave his toilet alone.

of work are done, but Scheme 2 still beats Scheme 1 by about 223,481 units of work. Table 1 summarises the numbers for the various cases. In fact, you can run this simulation yourself by choosing your own parameters at the following URL: http://popper.massey.ac.nz/~ARaman/toiletseat/simulate.html

It is obvious from Table 1 that even when the the ratio of men to women is wildly exaggerated, Scheme 2 still outperforms Scheme 1. For instance, when there are 10 men and 1 woman in the house, the work done using Scheme 1 is 1,817,598 units whereas using Scheme 2 it is only 165,789 units. What is even more striking in this case is that even when we average the work under Scheme 1 over all the men, we find that each male individually does more work on average (181,759 units) than the total work done by everyone under Scheme 2! Only in the pathological case where one male shares a toilet with a thousand females does the efficiency of Scheme 1 begin to approach that of Scheme 2, and that too unfairly.

4 Statistical Analysis

Here is an explanation in theoretical terms for the figures in Table 1. If you are not a statistically inclined kind of person, or are not intrigued by why the figures in the table are what they are, you may skip this section.

Suppose that the ratio of males to females in the house is x, i.e. there are x males for each female. Then it follows that the probability that a randomly chosen toilet visit is made by a male equals $x/(x+1)$ and that it is made by a female equals $1/(x+1)$. If we denote the total number of toilet visits by k, then the expected number of male visits among them is just the product of k and $x/(x+1)$ which is $kx/(x+1)$. Under Scheme 1, since 2 units of work are done during a male visit and none at all during a female visit, the expected

total amount of work done in k visits is $2kx/(x+1)$.

Under Scheme 2, one unit of work is done each time the sex of the toilet visitor is different from that of its immediately previous visitor. If we denote the male-visit event by M and the female-visit event by F and the sequence of events Y following X by XY, we seek $P(MF|FM)$. This is $P(M)P(F)+P(F)P(M) = 2P(M)P(F)$. Thus the probability of a visit to the toilet being made by a person of different sex from that of its immediately previous visitor is $2x/(x+1)^2$. Consequently the expected total amount of work done in k visits under Scheme 2 is $2kx/(x+1)^2$.

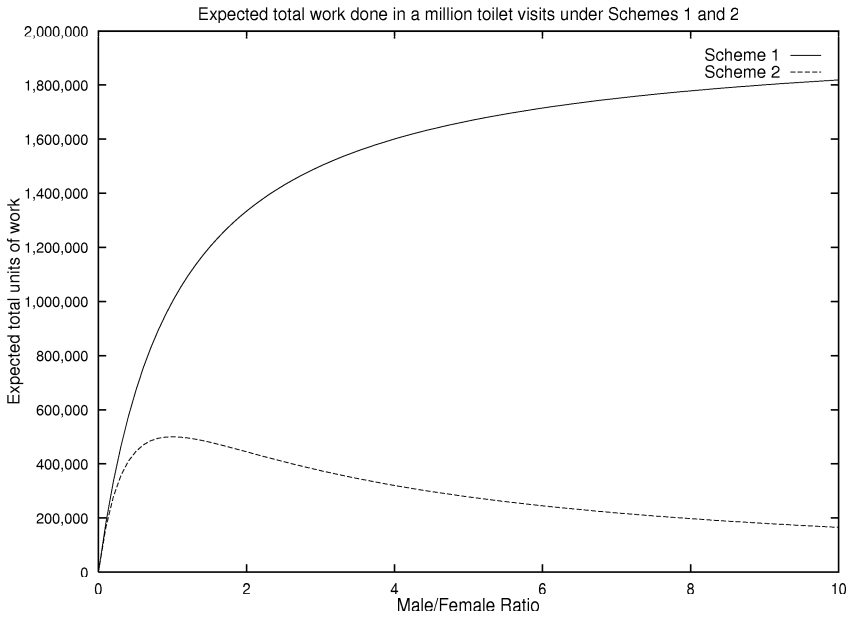

Figure 1: Plot of expected total work done under Schemes 1 and 2 for a million toilet visits.

Figure 1 shows a plot of the two functions representing work done under each scheme for a million toilet visits ($k = 10^6$) over a range of Male/Female ratios in the house. We can see that when the ratio is very low, i.e. when the women outnumber the men considerably, the efficiency of Scheme 2 begins to approach that of Scheme 1. This is to be expected intuitively since one can expect practically every male visit to be followed by a female visit and thus require 2 units of work in either case. However the total work done is also low since the males share a relatively low proportion of the toilet visits with the female. In contrast, consider the situation when the Male/Female ratio is very high, perhaps equal to the reciprocal of its previous value. Now the men outnumber the women considerably and the toilet visits tend to be dominated by males. Thus the work done under Scheme 1 is very high, but that under

Scheme 2 is the same as before.

While it should be obvious that $2kx/(x+1)$ is at least $2kx/(x+1)^2$ for non-negative k, one may also look at the difference between the expressions for expected work done under Schemes 2 and 1. $\frac{2kx}{(x+1)} - \frac{2kx}{(x+1)^2} = \frac{2kx^2}{(x+1)^2}$. That this quantity is at least zero for non-negative k testifies that the best that Scheme 1 can do is only approach Scheme 2 in efficiency.

5 A Third Scheme, Conclusion

At this point, I hope I have developed considerable conviction in the reader that Scheme 2 is the fairest and most efficient of all schemes to address the problem at hand. Unfortunately, however, as the astute reader will promptly point out, it is obviously not the nicest or kindest scheme. The male in the house usually scores no points with the female for picking efficiency over kindness. Is it possible then to conceive of a scheme which has the best of both worlds? That is, can we come up with a scheme that is both efficient and kind at the same time? It turns out that we can, on face value at least. Let's call this Scheme 3. This scheme is identical to Scheme 2 in every respect, except for the fact that when the woman finds the toilet seat up before use, all she has to do is to signal the man to lower it for her who in turn gladly complies. The essence of Scheme 3 is really the clever integration of the elements of kindness from Scheme 1 and efficiency from Scheme 2. But then, although Scheme 3 is both efficient and kind in principle, it turns out to not be very workable in practice. We briefly experimented with this scheme at home, only to quickly discover that it was actually quite cumbersome and inconvenient, especiallly when I bicycled to work instead of driving. Thus Scheme 3 is of theoretical value only. It should now be indisputably clear, therefore, that Scheme 2 is by far the best one to adopt in a dual sex household where arguments arise regarding whether the toilet seat should be left up or down by men.

However, all analysis aside, it is now time to confess meekly in small print that Scheme 1 is the one that rules in our home in spite of my having established the technical superiority of Schemes 2 and 3 long ago. But then, again, it is only because we both recognise the act for what it is. If you are undecided about which scheme to follow in your home, then cut this article out and paste it on your toilet door to read and appreciate at your leisure. See if it makes a difference. If your partner doesn't appreciate it, at least the toilet seat is bound to, if it can.