examiners may award marks out of one hundred for a particular examination, which is really an interval scale since the zero point is rarely used. Overall degree classifications, however, are usually based on the cruder ordinal scale of first, upper and lower second, third and pass.

Nominal numbers

Finally the fourth, least precise numbering system in common use is the nominal scale, so called because the numbers really represent names and cannot be manipulated arithmetically. Staying with our football example, we can see that the numbers on the players' shirts are nominal (Fig. 5.4). A forward is neither better nor worse than a defender and two goalkeepers do not make a full back. In fact there is no sequence or order to these numbers, we could equally easily have used the letters of the alphabet or any other set of symbols. In fact, some rugby teams traditionally have letters rather than numbers on their backs as if to demonstrate this fact. The only thing we can say about two different nominal numbers is that they are not the same. This enables the referee at the football match to send off an offending player, write the number in his book, and know that he cannot be confused with any other player on the pitch. It used to be the case that the numbers on football players' shirts indicated their position on the field, with goalkeepers wearing '1' and so on.

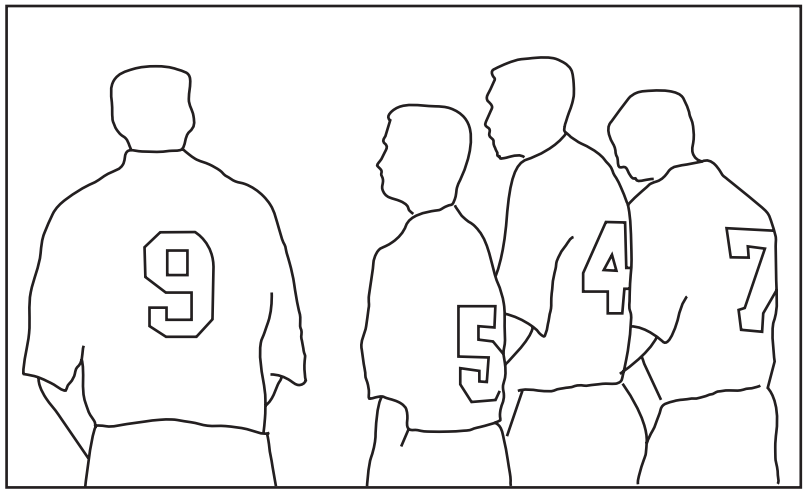

Figure 5.4
Numbers used as names – the nominal numerical system

The introduction of so-called 'squad numbering' removed this meaning from the numbers and was not surprisingly objected to by the traditionalist supporters.

Combining the scales

It is apparent, then, that only numbers on a true ratio scale can be combined meaningfully with numbers from another true ratio scale. We cannot combine temperatures from different scales, and certainly we cannot add together numbers from different ordinal scales of preference. Imagine that we have asked a number of people to assess several alternative designs by placing them in order of preference. These rank scores are of course ordinal numbers. We simply cannot add together all the scores given this way to a design by a number of judges. One judge may have thought the first two designs almost impossible to separate, whilst another judge may have thought the first-placed design was out on its own with all the others coming a long way behind. The ordinal numbers simply do not tell us this information. Tempting though it may be to combine these scores in this way, we should resist the temptation!

One of the most well-known cases of such a confusion between scales of measurement is to be found in a highly elaborate and numerical model of the design process devised by the industrial designer and theoretician, Bruce Archer. He, apparently somewhat reluctantly, concedes that at least some assessment of design must be subjective, but since he sets up a highly organised system of measuring satisfaction in design, Archer (1969) clearly wants to use only ratio scales. He argues that a scale of 1–100 can be used for subjective assessment and the data then treated as if it were on a true ratio scale. In this system a judge, or arbiter as Archer calls him, is asked not to rank order or even to use a short interval scale, but to award marks out of 100. Archer argues that if the arbiters are correctly chosen and the conditions for judgement are adequately controlled, such a scale could be assumed to have an absolute zero and constant intervals. Archer does not specify how to 'correctly choose' the judges or 'adequately control the conditions', so he seems rather to be stretching the argument.

In fact Stevens, who originally defined the rules for measurement scales, did so to discourage psychologists from exactly this kind of