ASSESSING THE EFFECT OF HEROISM ON COMBAT EFFECTIVENESS

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INTRODUCTION

1. Heroic performance by the many has long been the implicit assumption in much combat modelling. However, in the understandable absence of universal heroism in the real world, combat degradation is the norm. Previous historical analysis conducted within CDA and its predecessors (DOAC and DOAE) was concerned with assessing the performance of rifles and machine guns in real combat and comparing the results with performance of these weapons in field trials (1). It was discovered that combat degradation in real life was very much greater than that experienced in field trials and exercises.

2. A preliminary study of combat degradation in anti-armour battles showed that worthwhile analysis would have to be deferred until suitable detailed historical accounts had been compiled. With the completion of the first two accounts, on the Battles of SNIPE (2) and MEDENINE (3), it became possible to carry out a sufficiently detailed analysis to determine anti-tank gun combat degradation. In addition the detailed studies provided insights into both leadership and individual heroism. Other sources have provided data which permit a more general, if less detailed analysis; these sources cover a wide range of tactical battles in which both tanks and anti-tank guns were used together, as distinct from the battles at MEDENINE and SNIPE which were mainly confined to tanks in attack and anti-tank guns in defence. In this paper, we also introduce the relevance of heroism to other combat and non-combat situations.

OUTLINE OF STUDY METHOD

COMBAT DEGRADATION ASSESSMENT

3. In the previous study, combat degradation factors for small arms were assessed by comparing their performance in real combat with that achieved in tactical field trials (1). This was possible because analysis had shown that the effectiveness of rifles and machine guns in close combat had changed little over the years; for example, the performance of modern small arms in trials could reasonably be compared with the performance of World War I and World War II weapons (1). This is patently not true for anti-armour weapons. DOAE field trials, such as Exercise CHINESE EYE, have been conducted using simulations of anti-tank guided weapons which did not exist at the time of World War II and indeed have only recently been deployed in real combat. Thus, a different way of measuring anti-armour combat degradation needed to be developed. The method devised, after examining combat performance, used the hypothesis that heroes, defined as those who received gallantry awards, would perform to their physiological limits and their weapons' physical limits and could thus provide the baseline against which the performance of the majority could be compared. Throughout this paper the estimated quantitative values of combat degradation are the values of the factors by which baseline performance needs to be multiplied. This estimate of combat degradation is, of course, conservative, in that the performance of heroes might not match the performance which could be achieved in tactical field trials situations; also because the significant difference in combat performance was found to be when at least one of the crew (or de facto crew) received an award. Thus, the baseline includes guns manned by crews below normal establishment and crews of which only one member's performance fulfils the criteria for heroes. Nevertheless, as will be seen, this does provide a significant division of weapons into two groups by effectiveness, and, although conservative, offers estimates of major combat degradation.
4. In the paper we will start by quoting simple examples then move successively to larger samples, using necessarily more complicated measures of effectiveness to do so. Nevertheless, the results remain robust. Apart from confirmation of initial results, the main effect of further analysis is to help define the basis of the different contributions.

**ANTI-TANK GUN COMBAT DEGRADATION EVALUATED FROM BATTLE HISTORIES**

5. From the detailed histories developed for this study some essential features of the MEDENINE, SNIPE and anti-tank actions in Greece emerged. The major factor to emerge from these actions is the clear distinction between the performance of guns manned by heroes, as recognised by awards of VC, DSO/DCM and MC/MM, and that of other guns. Study of the actions indicates that at the most between 20% and 30% of guns were manned by heroes. In addition to gun crews, these include heroes who were commanders at platoon, (anti-tank) company and battalion level who were present during the action and either participated in, or took over, the firing of the guns.

---

In the battle of Medenine in March 1943, Sgt I Andrews of 1/7 Queens won the DCM for his use of his 6 pounder gun to engage an enemy force of about 18 tanks, killing a total of at least 8 tanks. Quotations describing his role that, after awaiting opening fire until 5-6 tanks were within 1000m and killing 5 of them, he became involved in a duel with the survivors. His platoon commander, describing the heavy enemy fire, said:

"This fire was very heavy and not one unwise head was to be seen above ground during this outbreak. Nevertheless Sgt Andrews took up the challenge.... Sgt Andrews ordered his crew to take cover whilst he continued to load and fire the gun himself. He disabled two further tanks......"

Sgt Crangles, also of 1/7 Queens, also won the DCM for his use of his 6 pounder in facing another part of the same attack. This gun faced four separate attempted assaults during the day together with fire by the German tanks. *Its confirmed total claim was 14 tanks killed before the gun was disabled by a direct hit on the recuperator. The Brigade’s War Diary records that:

"...but for the determined conduct of this gun crew, there is a good chance that the enemy might have lifted the mines and broken down the wadi. There is no doubt that the gallant fight put up by this gun was a determining factor in stopping an initial breakthrough at this point".

In the battle of SNIPE in October 1942, Sgt Calistan won the DCM for his use of his 6 pounder in an attack by 8 tanks and several self-propelled guns. Under heavy enemy fire, Col Turner, Maj Bird and Corporal Francis redistributed ammunition from knocked out guns. An improvised team of Col Turner as loader and observer, Lt Toms as number 1 and Sgt Calistan as firer disabled 5 tanks and one of the guns in the first engagement but this left only 2 or 3 ammunition rounds. Lt Toms dashed 100 yards in his jeep to fetch more ammunition but the jeep was set on fire on the return journey, 10 yards short of the gun. Ignoring the flames, Col Turner and Lt Toms unloaded the ammunition and ran back to the gun. Sgt Calistan then knocked out the other 3 tanks with successive shots at a range of less than two hundred yards.
6. The detailed results from reconstructions (2, 3) are summarised in Table I. Here the performance of heroes and 'others' is compared in terms of the numbers of enemy tanks hit per target available per gun engagement. This normalisation to hits per target is based on DOAE trials results which indicate that rate of fire is proportional to target availability. It is also a better way of comparing the performance of individuals than using, say, targets hit, because it takes account of target opportunity. The cumulative distributions of hits/target/gun engagement for MEDENINE, SNIPE and Greece are illustrated in Fig 1. Most attention should be paid to the median or 50% values; for example 50% of non-heroes achieved just over .03 on the performance scale, whereas 50% of heroes achieved approximately .3, or 10 times, as many casualties.

**TABLE I**

ANTI-TANK GUN COMBAT PERFORMANCE: MEAN NUMBER OF TANKS HIT PER TARGET PER GUN ENGAGEMENTS

<table>
<thead>
<tr>
<th>CAMPAIGN/BATTLE</th>
<th>HEROES</th>
<th>OTHERS</th>
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<tbody>
<tr>
<td></td>
<td>Total Guns Deployed (and in Combat)</td>
<td>Total Gun Engagements</td>
</tr>
<tr>
<td>Greece (several)</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Alamein 2RB at Snipe</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Medenine Queens Bde</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Gds + Nz Bde</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td><strong>ALL</strong></td>
<td>26</td>
<td>49</td>
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</table>

* For example in one engagement, if a gun has 10 targets and hits 3 in that engagement then a figure of 0.3 hits per gun engagement is calculated. The mean for several engagements is the average of these rates.

7. Table I provides two broad estimates of the extent to which heroes participated in anti-tank battles. It shows that 26 out of 123 guns deployed, that is 21%, were fired at least once by heroes and heroes took part in 49 out of 172 engagements, that is 28%.

8. Table I also shows, very clearly, the higher combat performance of heroes whose guns achieved 0.275 target hits per target per engagement compared to only 0.052 by others. This difference is highly significant, statistically, also illustrated by the separate battle analyses.

9. Under the hypothesis that heroes are those not subject to combat degradation it is now possible to make a simple and conservative estimate of overall combat degradation. On the assumption that the performance of about 20% of deployed anti-tank gun personnel is not degraded, then the performance of the other 80% is degraded, by an average factor of 0.052/0.275 = 0.19. This gives an overall mean degradation factor of 0.2 x 1 (heroes) plus 0.8 x 0.19 (others) = 0.35. The conclusion from these figures is that performance by anti-tank gun crews in battle is only about one third of what could have been expected had they performed to the limitations set only by their weapons characteristics.
FIGURE 1
ATTACK TANK CASUALTIES/TARGET/GUN ENGAGEMENT FOR ANTI-TANK BATTLES STUDIED IN DETAIL
10. This simple estimate of combat degradation is conservative, not only because of the hypothesis that heroes are not subject to degradation, but also because the sample of battles examined here is biased in favour of successful defensive anti-tank battles. This could lead to an overestimate of the proportion of heroes. To obtain a more widely applicable estimate it will be necessary to examine overall performance in a wider sample of battles, including some in which defence positions were overrun. Work to produce this has continued and further estimates, using data currently available, are made later in this paper.

11. It was necessary to start with battles which involved only one type of anti-tank weapon and the study has concentrated on defence because experience gained from the small arms study suggested that combat degradation is greatest in defence. This set of conditions was present at MEDENINE, SNIPE and in a series of small anti-tank battles in Greece. In addition, some tentative estimates of tank combat degradation have been made; these are made possible by the effectiveness scale below.

THE RELATIVE EFFECTIVENESS OF TANKS & ANTI-TANK GUNS IN DEFENCE AND ATTACK

12. In any assessment of the relative value of tanks and anti-tank weapons from combat data, there is a fundamental problem in that, whilst casualties to both types of weapon have been recorded and the types of weapon have been recorded, the type of weapon responsible for each casualty has not. For tank versus tank battles empirical relationships between casualties and force ratios have been derived (4). In order to extend this procedure to include tanks and anti-tank guns of disparate morphology, and with differing crews, a further empirically determined factor ‘T’ has been introduced for guns. Essentially this is used to modify the gun quality index to the scale of tank quality index, allowing for the effect of the extra qualitative factors which differ between the two classes weapon. A detailed explanation of how the ‘T’ factor and ‘quality products’ were developed, together with examples, is Annexed.

13. A comparison of the ‘T’ factor of anti-tank guns manned by heroes and that attained by anti-tank guns in the wider sample was also used subsequently to estimate the proportion of heroes to non-heroes. This made it possible to extend the range of battles over which combat degradation could be assessed.

TANK/ANTI-TANK GUN EQUIVALENCE IN DEFENCE

DATA SAMPLES

14. The first estimate of tank/anti-tank gun equivalence, by the method outlined earlier was made using data from "unbiased" sets of WWII Western Desert tank/anti-tank battles (6). These were unbiased in that, unlike the battles of SNIPE and MEDENINE, they included unsuccessful as well as successful defences.

15. As the analysis proceeded, more data became available and estimates of the ‘T’ factor in defence (T_D) were also made for a number of North European battles. These were:

a. actions in Normandy involving a total of one hundred and twenty seven 75mm and 88mm German towed guns attacked by British and Canadian medium and cruiser tanks armed with 75mm (75%) and 17pdr (25%) guns (7);
b. seventeen separate actions involving a total of forty-nine 75mm and 88mm German towed guns attacked by US Sherman tanks of 3rd and 4th Armoured Divisions, presumably with a mix of 75mm and 76mm guns (8);

c. thirteen separate actions at Mortain involving 27 guns and twenty one actions in the Ardennes involving 38 guns in both cases the 57mm and 76mm US towed guns were attacked by German Pz IV and Pz V Panther tanks and SP guns (9-12).

RESULTS

16. The cumulative distributions of both defence and attack 'T' factors obtained from the Western Desert set of battles are shown in Fig 2. TD varies between 3 and 95 for individual battles and has a (geometric) mean of 23. Fig 2 is similar in format to Fig 1 but with the alternative measure of gun performance, the T factor, on the horizontal axis.

17. Before going on to consider the results of the analysis of the NW European battles, SNIPE and the battles in Greece, it is of interest to compare the "unbiased" Western Desert results with those obtained from the successful defensive battle at MEDENINE. This is done in Fig 3 which shows the cumulative distributions of TD for the MEDENINE battles alongside the Western Desert results. As might be expected, the mean value of TD, which can be considered to be a measure of the effectiveness of anti-tank guns in defence, is 30% lower in the Western Desert battles, although this difference is not statistically significant. This could be used to revise the previous degradation estimate by comparison with the same set of heroic performance figures, however further improvement in this is dealt with after more detailed analysis below.

18. Also shown in Fig 3 are the separate distributions of TD for heroes and non-heroes at MEDENINE. The difference between these two curves, by a factor of between 5 and 6, confirms the findings of the analysis of individual performance.

19. The (geometric) mean value for TD was calculated from each of the above data sources and was found to be consistent across all theatres of operation.
FIGURE 2
DISTRIBUTION OF ANTI-TANK GUN 'T' FACTORS FROM MIXED ANTI-TANK BATTLES IN THE WESTERN DESERT

NOTE: THE 'T' FACTOR REPRESENTS THE EMPIRICAL MULTIPLIER TO BE APPLIED TO A TOWED GUN FACTOR (CALCULATED AS FOR TANKS) TO REPRESENT ITS EQUIVALENT CASUALTY CAUSING CAPABILITY TO A TANK.

FOR 50mm PAK 38 THE CALCULATED FACTOR IS UNITY SO 'T' ALSO REPRESENTS THE TANK EQUIVALENCE OF THIS GUN.

FOR BRITISH GUNS CALCULATED FACTORS ARE 0.96 FOR 2PDR, 1.56 FOR 6PDR.
FIGURE 3
COMPARISON OF DEFENCE ANTI-TANK GUN 'T' FACTOR DISTRIBUTIONS, SEPARATING MEDENINE BATTLES.
20. For those battles in which only tanks participated, it was possible to obtain a fairly accurate estimate of the performance of tanks in the defensive role measured in terms of attack casualties per defending tank. A defence composed of tanks alone was less effective than defence by towed anti-tank guns alone or a mix of anti-tank guns and tanks. On the assumption that tanks in a mixed defence inflicted casualties at a rate no higher than that commonly achieved in a tank-only battle, the apparent kill rate of the guns appeared to be roughly a factor of 3 greater than that of the tanks, despite the relative disadvantage of guns in mobility, protection and traverse.

21. It was demonstrated in Ref (13) & (14) that this disparity between the performance of tanks and guns could be related to the different crewing of each, and in particular to the higher density of officers and SNCOs with deployed anti-tank guns. It was shown that this could be due partly to the higher incidence of heroism from those higher ranks.

A SIMPLE ANALYSIS OF INDEPENDENT DATA

22. The above analysis took into account the characteristics of both different tanks and anti-tank guns by means of the quality product and the 'T' factor. A simpler, empirical, analysis which ignored the quality of the different weapons was possible for a number of engagements in very different terrain in Normandy in 1944(7). In these actions British tanks, with a 3:1 mix of 75mm and 17pdr guns, attacked varying numbers of German tank and anti-tank guns. There was no significant difference between the effectiveness of the two types of tank but the ratio of anti-tank gun to tank effectiveness averaged 2.55, a value which supports the results of the more complicated analysis given above.

UNDERSTANDING THE REASONS FOR THE DIFFERENCE IN TANK & GUN EFFECTIVENESS

23. The above results may be surprising to many but not, perhaps, to the military historian Griffiths who wrote of tank casualties that "relatively few appeared to have been caused by enemy tanks" (15) or to Lucas Phillips who wrote that "in tank battles the dominant weapon was in fact the German anti-tank gun" (16) and "the anti-tank gunner, if well sited and strong of heart, really had the tank cold nearly every time" (17). Lucas Phillips had commanded an anti-tank regiment in the Western Desert. Possible reasons for the effectiveness of the anti-tank gun being greater than that of the tank in defence will be explored next.

24. Since the tank has greater protection, mobility and gun traverse, its combat effectiveness could be expected to be at least as good, possibly greater, than the towed gun even in defence. Thus the above result is surprising and the possible reasons for the large combat degradation are worth exploring.

25. Possible reasons for the large degradation are that:

a. the engagement process with tank crews could be linked, at some levels, to extra decisions of whether to engage and hazard an expensive weapon and its crew, analogous to the "Fleet in Being" concept in naval warfare;

1The "Fleet in Being" concept is a policy which uses the threat value of a fleet maintained intact, particularly the weaker fleet in a conflict.
b. additional mobility gives a viable option to withdraw a tank to safety;
c. there are different modes of fighting by tank and towed gun crews;
d. tanks have combat roles other than the destruction of enemy tanks.

26. While all of these reasons may make some contribution, the low level tactical studies described here have highlighted the value of individual gallantry in gun effectiveness and its relationship to responsibility and rank. This leads to another possible reason for the relatively high gun effectiveness compared to tanks: the difference in numbers of officers and senior NCOs to each weapon. For example, in a tank squadron there would be 16 tanks with 6 officers and 4 or 5 sergeants (when deployed), that is, approximately 0.65 SNCOs or above per tank. In contrast, the anti-tank battery (or company of a motor battalion) had a sergeant to each gun, with a troop leader and troop sergeant in addition to a battery or company commander with nearby infantry company commanders immediately interested in their success. This gives approximately 2 SNCOs or above per gun, a total of three times the equivalent for tanks. The difference also implies some significance in the accessibility of weapons to appropriate mobile or 'floating' commanders.

27. The effect of this high number of officers and NCOs can be illustrated by examination of a sample of identified heroic anti-tank gun crews from those battles studied in detail. The indications from this sample are that those manning and receiving the award, usually, but not always, included the SNCO gun crew commander, whereas only 20% of awards were to a lower rank (3 corporals, 1 rifleman). In addition, in 75% of cases, an officer or NCO senior to the gun crew commander was present and supervising or helping in some way.

28. Another interesting parallel can be drawn from Field Artillery practice when in the 'Gun Control' direct fire role against tanks. This practice developed from experience in a way which also produced extra higher level supervision and participation. A number of WWII actions have been studied in detail to examine the relationship of this practice and the resulting officer plus SNCO ratio per gun with weapon effectiveness.

**TANK/ANTI-TANK GUN EFFECTIVENESS**

29. A major factor that has emerged from this part of the analysis is the significance of anti-tank guns in World War II anti-tank combat. In particular it has been shown that in defence the anti-tank gun was more effective than the tank. This is not at all apparent from most historical accounts of combat, apart from those quoted and some which recognise the significance of certain German anti-tank guns.

30. It appears, therefore, that a blurred perception of the general significance of tanks and their anti-tank capability has emerged. Although effective in other roles they are not necessarily the most effective anti-tank weapon in defence. As a result, it appears that some areas of military history would benefit from a re-evaluation which would focus in particular on the roles, disposition and numbers of anti-tank guns in actions as well as those of tanks (whose numbers are frequently recorded in isolation). Such an evaluation is necessary for an objective understanding of casualties in armoured combat, particularly in the Western Desert. The other side of the coin, but of equal importance, lies in understanding and quantifying the true benefits of tanks in combat roles other than in the anti-tank battle.
FURTHER ANALYSIS

31. The initial phase had demonstrated the possible significance of gallantry and value of officers and SNCOs in supervision but only in the two battles studied in detail. The variation in effectiveness between other battles which were studied in less detail was greater than that within those two detailed battles. Was this due to variations in the incidence of heroism or gallantry? Clearly, the hypothesis would have to be tested on a much wider sample of battles than the highly successful defensive actions of SNIPE and MEDENINE. For this broader investigation, methods would have to be devised that were far less labour intensive than those used to set up the initial hypothesis. We extended our Western Desert samples of battles to cover nearly all major British anti-tank defences, including a variety of tank and anti-tank and field gun mixes, anti-tank guns both in ground role and on portee in a mobile role.

32. The accounts given of World War II anti-tank battles provide limited data on heroic actions and gallantry awards, only the outstanding being mentioned. The data used in this report therefore stemmed from a detailed search of the citations for gallantry in anti-tank combat by artillery and infantry units in the Western Desert and in North Africa, supplemented by a survey of other post-war citations including returning prisoners of war. Available data did not permit an analysis of enemy weapons in similar detail.

"HEROISM" IN BATTLE

"History as written and read does not divulge the source of leadership. Hence its study often induces us to forget its potency" Gen George S Patton Jr, The Secret of Victory.

33. Considered purely from the point of view of one estimating the likely effects of combat degradation, it is not the system of gallantry awards which is important but the pattern of behaviour which these awards reflect. Nevertheless, the awards are our best means of identifying this behaviour post hoc, and of linking it to other factors. For present purposes we need to be assured both that gallantry awards are useful and reliable measures of military performance, and that they reflect something fundamental and enduring about the way that men are likely to behave under fire, in order to extend beyond the examples of the detailed battles.

34. One qualification to these citations is that the recipient must be in a hazardous situation at the right time and observers must be present. But variation of opportunity is inherent in all tactical situations, even in field trials. In trials, for instance, it is commonly found that a weapon at the upper 15 percentile point will fire four times as many rounds as will a weapon at the lower 15 percentile point (18). The position taken in this report is the variation of individual weapon contributions is likely to be due simply to differences in opportunities to engage. Then it can be shown, on the basis of battle records, that the stresses of war, coupled with the heroism/non-heroism factor, increase this variability very considerably.

35. It would not be appropriate here to try to explain the variations in behaviour which, at one extreme, may result in a gallantry award. However, if we are to allow for it in combat models we need to understand its variability, especially the degree to which effectiveness may be seriously degraded. Here the classic descriptive account is by Marshall (19), based on extensive post-combat interviews of US troops. Marshall concluded that combat degradation rises in large part from effective non-participation by a significant proportion of those nominally involved. This conclusion is in line with the evidence collected during the course
of this study. Heroism is characterised by a willingness to participate actively in the battle whatever the circumstances, and its opposite by a refusal, or inability, to do so. Examples of heroic behaviour are given in the box below, contrasting with some of the apparently ineffective behaviour exhibited in the same context. In this study we shall attempt to quantify both the incidence of heroic behaviour and, in comparative terms, the relative contribution of the remainder. Two examples, both linked with gallantry citations, also point both to the direct importance of the presence of officers and senior ranks in combat or in their absence, to the zero gun effectiveness possible even with intact guns:

"Nearby there were three 6 pounders of the Sherwood Foresters, but the detachment had lost all its officers and the guns were unmanned. Sgt Trail of 34 Battery went over to them across 300 yards of bullet-swept ground and brought one of them single handed into action against the tanks." (20) - also Sgt Trail's Citation (21)

Similarly, in another action, in the late Alamein fighting only another citation (21) reveals the lack of action by guns sited to engage:

"Three enemy M.13 tanks approached the OP overrunning the infantry around it. Observing that none of our A/Tk guns had opened fire Captain FIELDING ran to the nearest gun whilst being shot at by machine guns from the tanks. He brought the gun into action and laying it himself succeeded in knocking out one tank and turning the other two back."

Another example emerged amongst accounts of one of the earlier Alamein heroic stands. A gun sergeant foraging for ammunition on a knocked out gun had left an NCO and gunner to keep his gun firing. He was surprised to see both leave the gun and return to the gun quad whose driver drove them away. Although he shouted at them to stop and fired six shots with his revolver they disappeared and were not seen again (22).

36. There may well be some physiological reasons why people act heroically, but all the evidence suggests that in the main it is a matter of genetics, social conditioning and values. We have identified different patterns of gallant behaviour in this study; several associations promise further study could enable us to follow the mechanism of unit effectiveness increasing with combat.

METHOD OF ANALYSIS

37. The method of analysis now adopted is summarised below:

a. The quantification, over a number of separate actions or battles of:

   (1) Allied weapons.

   (2) Enemy losses.

   (3) Associated Allied gallantry awards.

b. The calculation of the apparent effectiveness of Allied weapons and enemy losses.

c. The computation of the degree of association and numerical relationship between the number of gallantry awards per weapon and weapon effectiveness.
RESULTS

AGGREGATED COMBAT PERFORMANCE

38. The pooled plot of weapon effectiveness (T) against the number of gallantry awards per weapon are summarised for the different gun types in Figure 4 and Table II. The data in Table II pertaining to anti-tank guns has been split into subsets "with" and "without" mines and by gun type. In addition to approximately 40 actions from the detailed battles and Greece they included 80 separate battles, varying from the overrun of a brigade’s field artillery down to small groups and even individual weapons. All groups showed generally similar patterns but that with minefields, showed a (non-significant) trend to less variation in effectiveness with heroism.

FIGURE 4
THE EFFECT OF HEROISM ON DEFENCE GUN EFFECTIVENESS SUMMARY OF RESULTS

\[ r = 0.65 \]
TABLE II
SUMMARY OF DEFENCE GUN EFFECTIVENESS VARIATION WITH HEROISM

<table>
<thead>
<tr>
<th>DATA SET</th>
<th>DEFENCE EFFECTIVENESS (T)</th>
<th>Ratio from 0 to one hero/gun</th>
<th>Sample</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>At zero heroes/gun</td>
<td>At one hero/gun</td>
<td></td>
</tr>
<tr>
<td>Anti-tank guns in Ground Role</td>
<td>14.0</td>
<td>100.5</td>
<td>7.14</td>
</tr>
<tr>
<td>Ground role with mines</td>
<td>32.1</td>
<td>61.0</td>
<td>1.90</td>
</tr>
<tr>
<td>Field Guns</td>
<td>13.5</td>
<td>68.0</td>
<td>5.00</td>
</tr>
<tr>
<td>Porteeed Guns</td>
<td>14.6</td>
<td>64.4</td>
<td>4.40</td>
</tr>
<tr>
<td>Weighted Mean of all data</td>
<td></td>
<td></td>
<td>5.00</td>
</tr>
</tbody>
</table>

39. The factor of five, between heroes and others, confirms the results from detailed battle reconstructions. It is noticeable that the approximate aggregated methods used in the broad survey result in slightly lower correlation coefficients than the more detailed examinations in the preliminary investigation. This is almost certainly because they cannot reflect the less than ideal allocation of heroes to guns. Nevertheless, the association between heroism and combat effectiveness accounts for roughly one half of the variance of the latter. In numerical terms, taking the average performance of heroes as the standard at unity, this relationship can be expressed by the equation:

\[ \text{Expected combat performance}^* = 0.2 + (\text{Heroes per gun}) \times 0.8 \]

This equation holds up to a level of one hero per gun, above which the effect of additional heroes is greatly reduced.

*The effectiveness is relative to that which may be expected in peacetime field trials.

THE EFFECTIVENESS OF THOSE NOT RECEIVING GALLANTRY AWARDS

40. It will be noted from the aggregated analysis above that, even with zero heroes per gun, there is some residual combat effectiveness (estimated at 0.2 relative to the standard set by the heroes). It is necessary to turn to the detailed analyses to gain additional insights as to the likely nature of the contribution from those not in receipt of gallantry awards.

41. It seems from the detailed analyses that, excluding those weapons manned by crews who received gallantry awards, approximately one third of weapons made no effective contribution to the battle at all. Their effectiveness was, to all intents and purposes, zero. The remaining two thirds operated at an effectiveness level of roughly 0.3. Consequently, at zero heroes per gun the expected combat effectiveness is: \( 0.33 \times 0 + 0.67 \times 0.3 = 0.2 \).
42. This estimate of the proportions likely to contribute at different levels under fire ties in closely with the qualitative comments of Wigram (23) on infantry platoon members: "Every platoon can be analysed as follows: six gutful men will go anywhere and do anything; twelve 'sheep' who will follow behind if they are well led; and four to six men who will run away". The likely incidence of heroism will be dealt with in the subsection below, but, anticipating those results, our own findings are compared with Wigram's comments in Table III below.

TABLE III
COMPARISON OF THREE LEVELS OF EFFECTIVENESS IN COMBAT:
ANTI-TANK STUDY AND LT COL WIGRAM'S REPORT ON INFANTRY
PLATOON IN COMBAT

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>WIGRAM 1943 FOR INFANTRY Platoons (published 1991)</th>
<th>THIS ANTI-TANK STUDY WWII A/TK GUNS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Proportion</td>
<td>Level</td>
</tr>
<tr>
<td>MOST EFFECTIVE</td>
<td>0.25</td>
<td>'GUTFUL'</td>
</tr>
<tr>
<td>(0.15-0.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARTLY EFFECTIVE</td>
<td>0.52</td>
<td>'SHEEP'</td>
</tr>
<tr>
<td>ZERO EFFECTIVE</td>
<td>0.22</td>
<td>'WILL RUN AWAY'</td>
</tr>
</tbody>
</table>

43. These variations in effectiveness must now be linked to variations in the weapon system contribution arising simply from differences in opportunity to engage. In paragraph 34 it was mentioned that in field trials it is commonly found that a weapon at the upper 15 percentile point will fire four times as many rounds as will a weapon at the lower 15 percentile point. Put in statistical terms, the firing contribution of different weapons follows a log normal distribution, with a standard deviation equivalent to a ratio of 2. This finding holds good for anti-armour weapons and also for small arms in open, urban and even house clearance situations. Moreover, the effect changes little if measured from replicated battles on the same ground, or from a series of battles fought over fresh ground on each occasion.

44. For the purpose of separating the total variation in battle contribution into different components, the data from the detailed analyses has been divided into three groups: 'most effective', or heroes; the 'partly effective', or degraded; and the 'zero effective' group, who apparently did not participate at all. The effectiveness for the first two groups was computed in terms of the T index described above. The cumulative distribution of effectiveness indices for these two subsets is plotted in Fig 5 (It is, of course, impossible to plot a zero effectiveness group on a logarithmic scale). The important point to note here is that the slopes of the two lines through these two sets of data points both equate very nearly to a standard deviation representing a ratio of 2. This is the value obtained for variations in weapon performance in tactical trials of a range of situations, that is the variation due to weapon deployments as the forces meet. The conclusion must be that within each of the two groups, heroes and participating non-heroes, the variation in opportunities to engage approximates very closely to what might be expected from field trials. However, the heroism/non-heroism considerably increases the total variability in weapon system contribution and this superficially high variability is to be expected purely from this source, especially when the presence of the other extreme of the non-contributors are taken into account.
FIGURE 5
POOLED T FACTOR DISTRIBUTIONS FROM DETAILED ACTIONS FOR HEROES AND NON-HEROES (MENENINE, SNIPE AND GREECE)

PERFORMANCE OF INDIVIDUALS WITH PREVIOUSLY RECOGNISED GALLANTRY

45. The consistency of exceptional performance from those recognised for gallantry is a feature which emerges from regimental histories. Many cases are difficult to compare as gallantry can be manifested in many ways; and also many noted for gallantry subsequently receive promotion so their responsibilities change. Continuing gallantry has sometimes been recognised by further awards but in general it has required a more obvious act of gallantry to gain further awards, which is very evident from the comments moderating citations. Examples of bars to awards of the MC and the DSO are rare, and there have only been three cases of bars to the VC. Records of bars considered, compared with those awarded, indicates that a second award at any level requires a stronger case than does the first award.

46. Despite this, the records indicate that many receiving gallantry awards had previously obtained a mention in dispatches and there is also a significant group of multi-award winners testifying to continuing gallant performance. In addition the same names recur in unit histories for successive specific actions. Examples of such repeated gallantry can be cited but time prevents it in this paper.

47. A further comparison was made, building up a sample of guns manned by ‘heroes’ identified by awards in previous battles. From the anti-tank study it is possible to make a more quantifiable check on the subsequent performance of gallantry award winners, where those with previous awards take part in subsequent actions quantity in CDA analysis. A sample of nine such plotted in Fig 6 below shows a close approximation to that of the overall heroic set in Fig 5. The geometric mean 59 compares to 65 for the identified heroes (of Menenine, SNIPE and Greece). The standard ratio of the group approximates 2.2 for previous heroes compared to 2.1 for newly recognised heroes.
THE INCIDENCE OF HEROIC ACTION OR POTENTIAL

48. From the detailed surveys, it is possible to estimate the proportions of the officers, SNCOs and ORs associated with these World War II guns who received gallantry awards. The figures are shown in Table IV below.

TABLE IV
PROBABILITY OF HEROIC ACTION BY RANK GROUPS
(AS % OF THOSE ESTIMATED TO BE AVAILABLE FOR MANNING)

<table>
<thead>
<tr>
<th>GUN</th>
<th>Sample</th>
<th>Officers</th>
<th>SNCOs</th>
<th>NCOs and OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-Tank Guns</td>
<td>521</td>
<td>10</td>
<td>5.1</td>
<td>1.3</td>
</tr>
<tr>
<td>6 pdr</td>
<td>387</td>
<td>16</td>
<td>13</td>
<td>1.9</td>
</tr>
<tr>
<td>Field Guns</td>
<td>465</td>
<td>15</td>
<td>7.1</td>
<td>1.2</td>
</tr>
<tr>
<td>18/25 pdr</td>
<td>1435</td>
<td>14</td>
<td>8.4</td>
<td>1.3</td>
</tr>
<tr>
<td>Pooled (incl misc guns)</td>
<td>1435</td>
<td>10</td>
<td>5.1</td>
<td>1.3</td>
</tr>
<tr>
<td>Ratio: Officers:SNCOs:ORs</td>
<td>1.0</td>
<td>0.6</td>
<td>0.09</td>
<td></td>
</tr>
</tbody>
</table>

49. The figures in Table IV stem only from World War II infantry and artillery gun crews. In order to accept them as Army-wide estimates of the potential for heroic acts among the different ranks it is necessary to be assured that the proportions are not likely to differ very greatly in other groups. In Table V the results of a separate comparison based on a number of regimental histories of different arms are shown which illustrate, the ratio of awards to numbers killed in action (so that the exposure to risk is roughly equated). Taken overall, in regiments, the ratio of officers: SNCOs: ORs at the foot of Table IV is strikingly similar to that in Table V. It can be tentatively concluded that the association between rank and heroism is likely to be similar in armoured regiments to that already discovered in the infantry and artillery sample.

17
TABLE V
COMPARISON OF GALLANTRY AWARDS:
KILLED IN ACTION RATIOS BY RANK & ARM (WWII)
(SAMPLE OF UNITS)

<table>
<thead>
<tr>
<th>UNIT TYPE (SAMPLE)</th>
<th>AWARDS/KIA RATIO (GEOMETRIC MEANS)</th>
<th>OFFICERS</th>
<th>SNCO'S (SGT+)</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARMoured REGTs (10)</td>
<td>1.73</td>
<td>1.06</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>ARMoured CAR REGTs (5)</td>
<td>2.32</td>
<td>1.13</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>INFANTRY REGTs (9)</td>
<td>1.03</td>
<td>0.57</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>FD ARTILLERY REGTs (8)</td>
<td>1.90</td>
<td>0.70</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>A/TK REGTs (2)</td>
<td>1.25</td>
<td>0.67</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>OVERALL</td>
<td>1.56</td>
<td>0.81</td>
<td>0.10</td>
<td></td>
</tr>
</tbody>
</table>

TABLE V Ratio of Officers:SNCOs:ORs

THE EFFECTS OF SUPERVISION ON COMBAT EFFECTIVENESS

50. Supervision by undecorated officers and NCOs is another factor contributing to combat effectiveness and research is continuing in this area.

WEAPON SYSTEM COMPARISONS

“It is the unconquerable soul of man and not the nature of the weapon he uses which insures victory” Gen George S Patton Jr

51. A striking finding of this study is the apparently large variation in the extent to which different weapon systems have contributed historically to the anti-armour battle. Not only is the anti-tank gun in defence several times more effective as an anti-tank weapon than a tank, but in attack it is more effective as a tank killer too.

OTHER CASES BEYOND ANTI-ARMOUR COMBAT

GURKHA REGIMENTS

52. In contrast to the above comparisons between arms in the British Army, a comparison of gallantry awards for the British and the Gurkha battalions of the British Infantry in Fig 7 indicated a 70% higher level of recognition in Gurkha battalions than British (24). The geometric mean of the ratio of awards to killed in action was 0.105 for the British and 0.176 for the Gurkhas. A comparison of the combat effectiveness in defence of the British and the Gurkhas indicated a 53% higher level of effectiveness in Gurkha battalions than British. Thus this provides independent confirmation of a link between gallantry awards and combat effectiveness.

---

2 This comparison represents pooled ‘SNCOs + OR’ data to make the best use of available data.
AIR TO AIR COMBAT

53. Major variations in contributions by individual pilots involved in successive air to air combat opportunities have been noted and represented in simple models which indicate that a minority do most of the killing.

54. To obtain an unbiased sample in a form suitable for analysis, the total WW2 experience of the initial pilots within three RAF fighter squadrons was catalogued. Casualties and confirmed kills have been carefully assessed and allowances made for shared kills and unconfirmed claims.

55. A tentative first division of the sample has been made on a similar gallantry award basis to that for anti tank crews, with the exception that the performance over the total flying career has been considered, including that in the pre-award period, rather than that in particular engagements.

56. The separation into heroic and non-heroic does allow a preliminary division. For the pooled set (of 3 Squadrons totalling 86 pilots) this division indicates a three way grouping.

  42% heroic, mainly scoring 0.27 kills per sortie, so that for heroic behaviour, with one kill / sortie as unity, this group averaged 0.27 effectiveness.

  46% non-heroic, scoring at a lower rate of 0.15 kills per sortie.
IMPLICATIONS FOR COMBAT MODELLING

57. If combat models are to be made more realistic account must be taken, not only of the pattern of combat degradation revealed in this paper, but of the evidence from field trials of the manner in which the mobile battle is structured. Factors to be included are: the low rate of fire of defensive weapons, and the dependence of this rate on the density of the target array; the limited size of local actions in terms of weapon systems with the potential to engage; and, consequently, the variability of the contribution that individual weapon systems can potentially make to the battle.

58. The low rate of fire results from the fact that, in realistic conditions, each weapon system has a wide search arc which must be covered. Whatever confidence the defender may place on his ability to judge the probable avenue of approach of the attacking force, the need is always to be prepared for all round defence and for the unexpected enemy initiative, and for the possible failure of flanking weapons or units. In these search conditions the rate of fire for any given weapon system is linearly related to the number of potential targets available, for results up to 30 targets. As a result, mean rates of fire are low. As an example, for Chieftain tanks in defence with 10 targets available, the rate of fire was one round per minute.

ARMOURED COMBAT

59. Analysis of the interactive trials battles of Exercise CHINESE EYE III (16) has shown that each overall battle, (nominally of 30 tanks plus two in the headquarters detachment facing 14 to 16 defending anti-tank weapons) was split into a series of separate mini-battles. Each overall battle was composed of 5 to 15 (average 9) of such mini-engagements. The numbers participating in each mini-engagement averaged 5.4 weapons for the attacker and 2.5 for the defender. This fragmentation of the overall battle arises in part from intervisibility limitations, target priorities and difficulties in detection.

60. Because of this fragmentation of the battle, and variations in the ability of each weapon system to detect opponents even when there is nominally a line of sight between them, there is considerable variation in the number of rounds that each defending weapon system will fire. The number of rounds fired by any one weapon in a given action has been found to be log normally distributed, with a standard deviation equivalent to a ratio of 2.

61. If combat models are to be realistic, they must be structured to reflect the variability and limited numbers of opportunities to engage, as well as the difficulties in detection given that such opportunities occur. Then, if the stresses of actual battle are also to be taken into account, models must in addition include the allowance for the willingness, or ability, of each weapon system to take advantage of such opportunities. Guidelines for model structuring should therefore include the following:

a. Work out in advance the geographical dispositions of the defensive weapon systems.

b. Calculate the expected proportions of defensive weapons in the categories 'most effective', 'partly effective' and 'zero effective', in accord with the manning pattern assumed. Allocate these categories at random to the defensive weapons.
c. During the course of the putative battle determine the opportunities for engagement for each weapon system, taking account of detection effects.

d. Adopt the convention that 'zero effective' weapons never respond to such opportunities; 'partly effective' weapons respond on only 30% of these occasions (randomly determined); and 'fully effective' weapons respond on each occasion.

62. Most of the above argument has centred on attrition, but, manoeuvre is the key to the armoured battle. A model cannot simply deal with attrition in the abstract, ignoring the fundamental dimensions of time and space, or it will fail to capture the essence of manoeuvre warfare. If some weapon positions are overrun because their crews are not active, then the integrity of the defence could be compromised. Success in frustrating a breakthrough will depend on movements of assailant, and dispositions of defenders of the different levels of effectiveness.

INFANTRY COMBAT

63. In addition to the obvious parallel of defence effectiveness and gallantry illustrated by the Gurkha comparison, another factor of gallantry may require analysis in the infantry battle. This is the importance of gallantry in the attack when the charge of one man to take out one or two machine gun posts can determine the difference between an attack pressed home or a beaten attack force withdrawing. This still requires further study but the role is especially important to the infantry role because of its function in taking ground.

SELECTION IMPLICATIONS

64. Reaching beyond the realm of combat, a comparison with other separately derived divisions of behaviour in the face of danger appears in Table VI. Although the one classification of babies is not identical to three of the combat classifications, it is similar in that all show broadly the same proportions, as well as indicating a three-way division. Marshall’s two-way division indicates a 15% brave proportion, but does not subdivide the remainder.

TABLE VI

COMPARISON OF DIVISION OF INDIVIDUAL BEHAVIOUR IN CRISES

(Figures in %)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Brave</td>
<td>35</td>
<td>15</td>
<td>25</td>
<td>25</td>
<td>42</td>
<td>15</td>
</tr>
<tr>
<td>Intermediate</td>
<td>45</td>
<td>85</td>
<td>50-59</td>
<td>50</td>
<td>46</td>
<td>75</td>
</tr>
<tr>
<td>Timid</td>
<td>20</td>
<td></td>
<td>16-25</td>
<td>25</td>
<td>12</td>
<td>10</td>
</tr>
</tbody>
</table>

3 In his study Dr Leach observed that for some personal survival was the overriding consideration. Caution is therefore needed in correlating a strong survival instinct with gallantry. In disasters, there will be those whose actions are wholly selfish whilst, conversely, some of the 'wait for instruction' category, once stimulated into activity, may act with courage and a selfless regard for others.
65. Recognition of this division by four independent observers in five studies is itself an arresting phenomenon. Moreover in the two quantitative combat studies the distribution within groups is similar and, in the anti-tank case, the distribution is comparable to that found in simulated combat trials (14) & (23).

66. If this general three-way division is so widespread, can we recognise its relevance in selection of appropriate personnel for combat arms? If so, major improvement in combat effectiveness may be possible.

CONCLUSIONS

"Volumes are devoted to armaments; and only pages to inspiration" Gen George S Patton Jr. The Secret of Victory.

67. The analysis has shown that in those anti-tank defensive actions studied:

a. there are major variations in individual combat performance.

b. there was a strong statistical correlation between defensive performance, measured in terms of attacker casualties per gun, and the incidence of heroic acts, defined as those which results in gallantry awards (VC, DSO/DCM, MC/MM).

c. a 20-28% minority of weapons, of which part of the crew received gallantry awards for their performance, caused 50-75% of the casualties in the attacking forces.

d. the main group of those guns which were not heroically manned averaged one third the effectiveness of those which were so manned; a further minority group of zero effectiveness.

e. the probability that an individual acted heroically in combat was 0.14 for officers, 0.08 for SNCOs and 0.013 for JNCOs or ORs;

f. the mean combat degradation figure for towed anti-tank guns in infantry or artillery crewed dismounted weapons in defence, at World War II manning levels, is estimated at 35%.

g. the proportion of personnel who took an effective part in battles was dependent on the degree of apparent supervision by officers and SNCOs.

h. despite their severely limited mobility, protection and traverse, towed guns, with their higher ranking crews when in combat, were significantly more effective in terms of inflicting enemy casualties than were tanks. However, increasing the mobility of guns by mounting them on wheeled vehicles appeared to cause little change in combat effectiveness.

i. Most published histories of World War II present a misleading picture of anti-tank combat, in that they describe and enumerate tank strength at length, but anti-tank guns only occasionally.
68. Equally the implications for selection need to be carefully reviewed. The examples above show that the effects are far more general than anti-tank combat and a similar set of conclusions can be derived from other regions of the spectrum of combat.

69. Of special significance is the finding that the majority of heroes, whose combat performance has been evaluated, were officers or senior NCOs and that the immediate presence of officers with gun crews was frequently associated with high combat performance of those crews. The balance of investment between man and material is thus of demonstrated significance and should be reviewed. The implication here is that an increase in the ratio of officers and NCOs to other ranks with some anti-tank units could lead to increases in combat effectiveness of those units. This implication is based on robust findings. Such a change now deserves serious consideration and, could have far reaching consequences.

70. Overall the study of heroism and its effects offers the possibilities of improving combat effectiveness by a factor which would not require major equipment investment.
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NOTE ON ‘T’ FACTOR

A1. The starting point for the method is a study of pure tank versus tank battles at battalion level in the Western Desert (A1). Results of this study are given in Fig A1 which shows attack casualties per defender versus attack to defender force ratio. Tank quality or effectiveness is allowed for by a ‘quality product’ which takes into account lethality, protection and mobility. For example, consider battles in which there were just two types of defending tanks, A and B, and two types of attacking tanks, C and D. Then the points on the tank v. tank lines shown in Fig A1 would be derived as follows:

\[
\text{Attack Cas/Defender} = \frac{\text{Number of C Tank Casualties} \times Q_C + \text{Number of D Tank Casualties} \times Q_D}{\text{Number of A Tanks} \times Q_A + \text{Number of B Tanks} \times Q_B}
\]

\[
\text{Force Ratio} = \frac{\text{Number of C Tanks} \times Q_C + \text{Number of D Tanks} \times Q_D}{\text{Number of A Tanks} \times Q_A + \text{Number of B Tanks} \times Q_B}
\]

where \(Q_A\), \(Q_B\), \(Q_C\) and \(Q_D\) are the tank quality products.

For battles involving both tanks and anti-tank guns, the above equations are extended to take the form:

\[
\text{Attack Cas/Defender} = \frac{\text{Total Attack Tank Casualties} \times Q_T}{\text{Defending Tanks} \times Q_T + \text{Defending Anti-Tank Guns} \times Q_{AT} \times T_D}
\]

\[
\text{Force Ratio} = \frac{\text{Attack Tanks} \times Q_T + \text{Attack Anti-Tank Guns} \times Q_{AT} \times T_A}{\text{Defending Tanks} \times Q_T + \text{Defending Anti-Tank Guns} \times Q_{AT} \times T_D}
\]

where \(Q_T\) is tank quality product; \(Q_{AT}\) is anti-tank gun quality product; \(T_D\) and \(T_A\) are defence and attack T factors respectively. These T factors are necessary to account for differences in performance between tanks and anti-tank guns which occur in real combat and are not covered by the quality products. As illustrated in Fig A1, for a battle which had tanks only in attack but tanks and anti-tank guns in defence, \(T_D\) is estimated by the value required to bring each battle result back to the original tank versus tank only curve.

A2. Two baseline tank versus tank curves are shown in Fig A1; they are for battles in which the attack achieved surprise as well as battles in which it did not. Throughout this report the ‘no surprise’ curve was used to provide a conservative estimate of tank/anti-tank gun equivalence. Also shown on Fig A1 is the upper 95% confidence limit of the no surprise curve which can be used to produce a simple estimate of the lower 95% limit on the estimated values of T.

A3. Finally, by combining the values of T with the quality products for anti-tank guns and tanks equipped with the same gun, an estimate of tank/anti-tank gun equivalence is obtained. For example, consider the WWII 2 pdr gun as an anti-tank gun with quality product 0.96 and the Matilda II tank, equipped with the same gun, quality product 5.8 (reflecting greater protection and mobility). Suppose that battles which had contained both tanks and anti-tank
guns in defence had yielded a mean value of $T_D = 20$. Then the number of Matilda II tanks equivalent in defence firepower to the 2 pdr anti-tank gun would be $0.96 \times 20 \div 5.8 = 3.3$

**FIGURE A1. ILLUSTRATION OF DERIVATION OF VALUE OF T FACTOR & EFFECTS OF SURPRISE, USING RELATIONSHIPS FROM ARMOURED (TANK v TANK) BATTLES IN THE WESTERN DESERT.**

**REFERENCES**

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