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Killer Incentives: Status Competition and Pilot Performance during World War II
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ABSTRACT

A growing theoretical and empirical literature shows that public recognition can lead employees to exert greater effort. However, status competition is also associated with excessive expenditure on status goods, greater likelihood of bankruptcy, and more risk taking by money managers. This paper examines the effects of recognition and status competition jointly. In particular, we focus on the spillover effects of public recognition on the performance and risk taking of peers. Using newly collected data on monthly "victory" scores of more than 5,000 German pilots during World War II, we find that status competition had important effects: After the German armed forces bulletin mentioned the accomplishments of a particular fighter pilot, his former peers performed considerably better. This outperformance varied across skill groups. When a former squadron peer was mentioned, the best pilots tried harder, scored more, and died no more frequently; in contrast, average pilots won only a few additional victories but died at a significantly higher rate. Hence our results show that the overall efficiency effect of nonfinancial rewards can be ambiguous in settings where both risk and output affect aggregate performance.

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I. Introduction

Humans crave recognition. In the *Theory of Moral Sentiments*, Adam Smith defined "bettering our condition" as "to be observed, to be attended to, to be taken notice of with sympathy … and approbation." From baseball's Hall of Fame to the Congressional Medal of Honor, from the fellowships of scholarly societies to the employee-of-the-month award, symbolic rewards exploit the human need for approbation as a motivating force. By creating an artificial scarcity, awards are meant to spur effort and increase output (Bénabou and Tirole 2003, 2006; Frey 2007; Moldovanu et al. 2007; Besley and Ghatak 2008).[1] Empirical evidence from the field and from experimental settings suggests that nonpecuniary rewards generally lead to reduced absenteeism, greater effort, and higher accuracy (Markham et al. 2002; Kosfeld and Neckermann 2011; Ashraf et al. 2014a; Chan et al. 2014).[2]

At the same time, "[a] medal glitters, but it also casts a shadow" (Winston Churchill).[3] Competing for awards and recognition is similar to other forms of status competition, from conspicuous consumption to prominent donations (Veblen 1973; Glazer and Konrad 1996; Frank 2010; Layard 2005). A recent literature has shown that relative status concerns are real and can have negative effects. The *neighbors* of lottery winners spend much more on cars (Kuhn et al. 2011) and face substantially higher risks of bankruptcy (Agarwal et al. 2016).[4] Consumers of financial services demand the same products purchased by their peers because of social learning and because consumers are affected by the utility of what others have (Bursztyn et al. 2014). Similar effects also obtain in the workplace. Card et al. (2012) and Ashraf et al. (2014b) show that job satisfaction and performance suffer from direct rankings and explicit comparisons with others in the same group.[5] The net effect of competing for relative standing and symbolic awards may be ambiguous: the result may be to "crowd in" effort, giving rise to social multiplier effects; alternatively, competition effects may crowd out effort as a function of relative rank or innate skill (Frey and Oberholzer-Gee 1997; Dohmen 2008; Ariely et al 2009; Apesteguia and Palacios-Huerta 2010; Gonzalez-Dias and Palacios-Huerta 2016).[6]

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[1] Career concerns and a desire for reciprocity may drive the incentive effects of symbolic awards (Dewatripont et al. 1999a, 1999b; Fehr and Schmidt 1999).

[2] Neckermann et al. (2014) find that employees continue to perform strongly after receiving an award. Malmendier and Tate (2009) fin the opposite – superstar CEOs significantly underperform after receiving major awards.

[3] Cited in Knowles (2014, p. 215).

[4] Cf. also Luttmer 2005. Bertrand and Morse (2016) show that, in US states with rising inequality, the bottom 80% spend a higher proportion of their income. Relatedly, Borowiecki and Kavetsos (2015) show that more competition between composers was associated with higher mortality.

[5] Charness et al. (2014) show that informing individuals of their relative performance may increase unethical behavior.

[6] Ashraf et al. (2014b) find that explicit rankings undermine effort whereas awards increase them. Schwarzwald et al. (1992) also report that social comparisons increase absenteeism, and Greenberg

In this paper we look at the joint effects of recognition and status competition. The focus is on the spillover effects of public recognition on the performance and risk taking of peers. We use new monthly data on victory claims for all German pilots with at least one such claim in World War II – a data set that includes the highest-scoring aces of all time. Aerial combat is an ideal setting for analyzing the incentive effects of public recognition: the stakes are high, effort is extremely difficult to observe, and principal–agent problems are rife. In a single-seater fighter plane, the pilot operates alone; and once a battle is joined, there is no effective control of individual planes by superior officers. Each pilot was responsible for deciding whether to pursue victory or break off contact. Pilots could try to boost their score by flying more days a week, flying additional sorties per day, and taking extra risks during missions.

Although it cannot be known ex ante whether status competition will sharpen or instead dull incentives there is ample anecdotal evidence that such competition was a strong motivating force. During the Battle of Britain in the summer of 1940, for example, two German aces – Adolf Galland and Werner Mölders – were neck and neck in terms of total victories (Galland 1993). When Mölders was ordered to confer with the head of the Luftwaffe, Hermann Göring, he went to Berlin for three days of meetings but only on the condition that Galland be grounded for the same number of days. Remarkably, at a time when the air battle against Britain hung in the balance, Göring (himself a WWI fighter ace) accepted that one of his best pilots would be grounded for no militarily justifiable reason.

We combine data on social distance in pre-existing networks with data on the timing of awards to demonstrate that public recognition systematically crowded in effort. Fellow pilots tried harder after another fighter pilot received public recognition, significantly increasing their score of aerial victories during the month in question. This effect was especially pronounced for the best pilots, among whom competition was intense, and for those who were closest (in terms of social distance) to the pilot receiving recognition. To examine the effects of such public recognition, we focus on mentions by name in the German armed forces daily bulletin (*Wehrmachtbericht)*.[7] We take this approach for several reasons: First, mentions were rare and were reserved for recognizing spectacular accomplishments (e.g., a very high number of enemy ships sunk, tanks destroyed, or fighters shot down, either cumulatively or over a period of time). Second, mentions became known instantly over a wide area since they were broadcast on the radio, published in the press, and distributed at command posts throughout German territory. Third, mentions in the daily bulletin were largely unexpected; there was no straightforward rule that "entitled" a pilot to

(1987) and Cohn et al. (2014) find that such comparisons reduce effort. Competing against a superstar (e.g., Tiger Woods in a golf tournament) may likewise reduce effort (Brown 2011).

[7] We draw on Wegmann (1982), an edited compendium of all *Wehrmachtbericht* issues.

being mentioned. Fourth, mentions in the *Wehrmachtbericht* were a fleeting form of recognition – providing the recipient with nothing more tangible than a short-term elevation of status in the eyes of others. For all these reasons, we consider those mentions in the daily bulletin to be a useful source for identifying variation as we analyze the effects of status competition.

The top panel of Figure 1 shows the average victory score for aces and non-aces when a former peer (from the same squadron) is mentioned in the daily armed forces bulletin. We exclude peers still serving in the same squadron in order to avoid contamination from correlated shocks. Aces always scored more, but they increased their monthly victory rate by 1.1 victories (over the base level of 1.9) when a fellow pilot was mentioned in the bulletin. In addition, non-aces scored 0.12 victories more than their baseline of 0.23.

[*insert Figure 1 about here*]

Pilots who are no longer serving in the same unit are unlikely be exposed to correlated shocks. The results hold when we impose a "minimum distance" requirement between the two units. We interpret these effects as being driven by competition for status in the spirit of "keeping up with the Joneses". Moreover, we provide evidence ruling out a variety of alternative interpretations: learning about one's own type, common shocks to peers, joint learning of particular skills in the past, and differences in equipment available to pilots.

As the monthly rate of aerial victories by peers increased, so did the casualty rate. This raises the question of whether social multiplier effects may have compromised the Luftwaffe's overall fighting efficiency. The best pilots reacted to awards bestowed on competitors by increasing their own performance, and their exit rate actually declined (a little).[8] Yet even though average pilots also tried harder, they paid a high price in the form of much greater casualty rates (Panel B, Figure 1). We are not in a position to assess how the "mentions" system affected efficiency overall, but there are some reasons to believe that it may have reduced the German air force's effectiveness.

Our work relates to the literatures on tournaments and peer effects. There are strong theoretical grounds for believing that – in a single-shot setting – tournaments can induce greater effort from participants (Lazear and Rosen 1981; Green and Stokey 1983; Nalebuff and Stiglitz 1983a, 1983b). However, many tournaments are dynamic in nature. Scholars have increasingly examined the effects of information release in such a setting (Lizzeri et al. 2002; Yildirim 2005; Aoyagi 2007; Ederer 2010; Goltsman and Mukherjee 2011). Genakos and Pagliero (2012) show how risk taking in

[8] Once we analyze exit including controls using survival analysis, we find a (small and insignificant) increase.

professional weightlifting competitions follows an inverted-U curve as a function of relative standing. Fershtman and Gneezy (2011) similarly find that increasing the stakes of a tournament can lead to more effort yet also to quitting by lower-ranked competitors.[9] Our own results indicate that status concerns can indeed promote risk taking, and we demonstrate this dynamic in a setting with high stakes (and no tangible upside, financially). Far from pilots "giving up", though, we find additional effort exerted and greater risks taken – with deadly consequences.

The rich literature on peer effects studies how collaborating with others affects worker effort and performance (Falk and Ichino 2006; Mas and Moretti 2009; Bandiera et al. 2010). Peer effects are typically driven by knowledge spillovers, task complementarities, or social pressure. In our setting, the first two of these drivers can essentially be ruled out. It is worth remarking also that evidence for peer pressure is relatively strong for low-skilled individuals but is distinctly mixed among the highly skilled (Jackson and Bruegmann 2009; Azoulay et al. 2010; Waldinger 2012). In this paper we offer an example of social interactions creating greater incentives to perform among highly skilled (and motivated) individuals.

Finally, we contribute to the literature on the determinants of military performance. Classic studies in military history have emphasized the importance of collaborative efforts (Stouffer et al. 1949; McPherson 1997; Van Creveld 2007). Along these lines, unit cohesion has been shown to be higher when soldiers are from similar backgrounds. For instance, Costa and Kahn (2003) document lower rates of desertion from units with low occupational and birthplace fragmentation; these authors also report that survival rates in a prisoner-of-war camp were much higher for prisoners embedded in richer social networks (Costa and Kahn 2007). In contrast to the literature emphasizing the importance of joint production and unit cohesion in military units, we emphasize the importance of individual incentives and of competition.

Our results are of general interest despite the highly specific nature of this study. We present novel evidence that the effects of symbolic rewards depend on social context. Status competition can lead to a crowding in of effort. At the same time, high-powered incentives – in the form of public recognition – may backfire precisely because concerns about status can induce too much risk taking. A clear analogy is the performance incentive in the compensation that a financial institution pays to its traders; in that case, the desire to be the "best" trader can lead to catastrophic losses.[10]

[9] For example, Brown (2011) shows that golf players underperform when competing against Tiger Woods.

[10] The closest paper to ours in spirit is the one by Brown et al. (1996), who show that relative performance incentives can lead to excessive risk taking in asset management.

The paper proceeds as follows. Section II provides background on the German air force during World War II and on the data we use. In Section III we present the main findings, and Section IV discusses alternative channels and interpretations. We conclude in Section V.

II. Historical Background and Data

In this section we describe our study's setting: the organization of the German air force in World War II; and its rise and fall as a fighting force. We also discuss the sources and limitations of our data.

A. German air force during World War II

Aerial combat began during World War I. Initially, planes were unarmed. They quickly evolved into specialized types, ranging from single-seat fighters to bombers. During that war, the highest-scoring ace – the "Red Baron" Manfred von Richthofen – notched 80 victories (Castan 2007). By the time World War II began, both fighters and bombers had become faster and more powerful. The German air force had sent planes and men to participate in the Spanish Civil War (on Franco's side), gaining valuable experience. There, the Luftwaffe carried out the first mass bombing of a civilian target at Guernica in 1936. German air support was crucial for the ultimate victory of the fascist forces (Westwell 2004).

The German air force was organized into air fleets composed of several flying corps. The flying corps contained several wings (*Geschwader*), most of which comprised three groups each consisting, in turn, of three or four squadrons (*Staffel*). Each squadron had an authorized strength of twelve aircraft, but actual strength could be as many as sixteen or as few as four or five aircraft (Stedman and Chappell 2002).

The German air force began the war in 1939 with 4,000 planes, including 1,200 fighters, and 880,000 men (Kroener et al. 1988). It had initially been designed for joint arms operations; during the Blitzkrieg campaigns, it mostly operated as close air support for the army. The wars against Poland, France, and Russia opened with successful attacks on enemy air forces, destroying many planes on the ground. This tactic ensured that the Luftwaffe quickly achieved air superiority. The only exception before 1943 was defeat in the Battle of Britain. There, Germany's failure to dominate the skies ultimately led the planned invasion of the British Isles being called off.

By 1943, both personnel and the number of planes had approximately doubled (since 1939) to 2,000,000 men and some 7,000 planes (Kroener et al. 1988). As the Allied bomber offensive against German cities gathered pace, ever more fighter units were called back to defend the Reich. Air attacks on hydrogenation plants and on airframe and aero-engine factories threatened the Luftwaffe especially, and from 1943 onward its efforts were devoted mainly to fending off the growing tide of bomber incursions.

Despite these efforts, German cities were quickly reduced to rubble as the strength of British and American air forces continued to increase.

Having started the war with modern planes and a large air fleet, Germany first lost its quantitative edge. Once it invaded Russia and US forces joined the fight, the Luftwaffe was heavily outnumbered in all theatres of war. It eventually fell behind also in terms of equipment quality; the outdated BF-109 remained Germany's main fighter plane until the war ended. New planes with advanced technology, such as the ME-262 jet, arrived too late to make a difference. Pilot training suffered in addition. Until 1942, German pilots received at least as much training as their Allied counterparts; but by 1944, a typical German pilot accumulated less than half the flying hours of UK and US pilots before being sent into combat (Murray 1996).

Loss rates rose to staggering heights. During January 1942, the air force lost 1.8% of its fighter pilots; by May 1944, it was losing 25% of them every month (Evans 2009). Destruction of planes was even more rapid. The Luftwaffe lost 785 planes in combat (and another 300 in accidents, etc.) during the six months between May and December 1940; between January and June 1944, it lost 2,855 aircraft in combat (plus another 1,345 in accidents). Actual planes available relative to authorized strength fell from 95% in January 1942 to 45% in September 1944 (Murray 1996). Nonetheless, due to the prolific output of German armament factories, the actual number of fighters in combat units rose until the end of 1944.

Air attacks against German cities may not have dented morale as much as British planners had hoped, and "precision" daylight bombing by the US air force destroyed much less industrial capacity than anticipated. Even so, the Anglo-American air offensive was clearly able to degrade substantially the German air force's capabilities – to the extent that the Normandy landings in the summer of 1944 were largely unopposed from the air (Neillands 2001).

Although the Luftwaffe lost air superiority in the West from 1942–1943 onward, it continued to be a match for the Red Air Force almost until the war's end. Outdated planes like the *Stuka* dive bomber were withdrawn from Western theatres after 1942, but they continued to operate successfully in the East until 1945. Better training and better equipment gave German units an edge against Russian planes and pilots; when it made an effort, the Luftwaffe could establish temporary air supremacy on the Eastern Front. Not until late 1944 did it began to lose that ability as more and more units were transferred to the Western Front.

B. Public recognition

A mention in the daily bulletin was among the highest forms of recognition given by the German armed forces. A typical report would describe only major events at the different fronts, listing gains and losses of territory or individual battles. Mentions were rare: during the entire war, fewer than 1,200 men were recognized in this way (Wegmann 1982) out of the 18 million German men who served.[11] Mentions by name were introduced in April 1940. One of the first soldiers receiving this recognition was Erwin Rommel for his role in leading the German armoured thrust into France in the spring of 1940. A typical example is Hans-Joachim Marseille's second mention on June 18, 1942: "First Lieutenant Marseille shot down ten enemy planes in a 24 hour period in North Africa, raising his total score of aerial victories to 101" (Wegmann 1982).

The *Wehrmachtbericht* was produced by the propaganda department within the operations staff of the German armed forces and under the direction of General Hasso von Wedel. Like all propaganda produced by the Third Reich, it skilfully mixed truth and distortions to create support for the war and the regime (Scherzer 2005). Highlighting the superiority of German fighting men was an integral part of this strategy.

Mentions in the daily bulletin were part of an elaborate system of awards and medals operated by the German armed forces. Some were widely distributed, such as "campaign medals" handed out to every soldier who participated in a particular operation – one example is the Russia 1941 campaign medal, commonly known as the "Order of the Frozen Flesh". Some awards recognized particular skills or feats of arms, such as the close-combat badge and tank destruction badge. The primary medals for valor were the Iron Cross (1st and 2nd class) and the Knight's Cross. By the end of the war, four additional types of the Knight's Crosses had been introduced. During World War II, about 3.3 million Iron Crosses 2nd class were awarded but only 7,300 Knight's Crosses, 890 Knight's Crosses with Oak Leaves, 160 with Swords, 27 with Diamonds, and one with Golden Oak Leaves.

C. Data

The high command of the German air force (*Oberkommando der Luftwaffe*, OKL) received fighter claims throughout the war. A special staff for recognition and discipline was in charge of collecting and validating claimed aerial victories. Pilots were required to file extensive documentation before a claim was recognized. The OKL records contain information on every reported aerial victory of German fighter pilots during WWII by wing (*Geschwader*), unit (*Gruppe*), squadron (*Staffel*), and pilot's name and rank as well as by the day, location (grid reference), type of damage, witnesses, and type of the claimed aircraft.

German rules for counting a claim as an aerial victory were relatively demanding (Caldwell 2012). Each claim had to be accompanied by a witness' report confirming

[11] There are 1,182 individual surnames in the *Wehrmachtbericht*. Because first names are not always recorded, there could be as many as 1,739 soldiers mentioned (if each mention with an identical last name is of a different subject).

either the destruction of the enemy plane (impact or explosion in the air) or that the enemy pilot was seen bailing out. Many claims were not accepted, and rightly so. There is some evidence of "over-claiming", by 50-100% in some cases, on the part of both the Western and German air forces (Caldwell 2012), when the records of German and British squadrons are compared, for example. It was not unusual for claims to be investigated further before being finally accepted or disallowed. This has probably less to do with systematic dishonesty, and more with the highly volatile conditions of air combat itself (Galland 1993).

Our database of German fighter pilots during WWII draws on two principal sources: Jim Perry's and Tony Wood's *Oberkommando der Luftwaffe* combat claims list, and the Kracker Luftwaffe Archive.[12] The OKL fighter claims list was extracted from microfilms of the handwritten records of the Luftwaffe Personalamt stored at the German Federal Archives (Bundesarchiv) in Freiburg. Because some OKL fighter claims records did not survive the war, Tony Wood augmented the list with claims from other published sources – such as Donald Caldwell's (1996) JG26 war dairy – to obtain a comprehensive list of German fighter claims for the years 1939–1945.

We clean the Perry–Wood fighter claims records by correcting typos (e.g., misspelled names, incorrect rank or unit) and then construct a monthly panel by aggregating the information for every pilot by month and year. This panel contains the number of monthly victories per pilot together with pilots' first and last name, rank, wing, unit, and squadron. We then match the panel data with additional information from the Kracker Luftwaffe Archive. Kracker's archive consists of data collected from many sources of detailed personal data on German fighter pilots, such as their war status (e.g., killed in action, prisoner of war, WWII survivor) and for some pilots also the starting date of their Luftwaffe career. Thus for every pilot in the sample we have information on when he received an award, his war status, and how long he was active during WWII. Our first observation of a pilot is typically when his first OKL claim is filed; our database does not include pilots who never scored during combat.

Our analysis employs information based on day fighter pilots. This is because the tasks and skills required of night fighter pilots were substantially different. Whereas day fighters often battled against other fighter pilots, night fighters were mainly used to intercept bombers (Murray 1996).

The sample is unbalanced and consists of more than 5,000 fighter pilots of the German Luftwaffe that made at least one combat claim during WWII. Pilots are observed for 19 months, on average, yielding a total of 96,127 observations. Of the 5,081 pilots in our data, 3,242 (or 64%) exit the sample – which means they are not in

[12] For more information about Tony Wood's combat claims list and the Kracker Luftwaffe Archive, see https://web.archive.org/web/20130928070316/http://lesbutler.co.uk/claims/tonywood.htm and http://www.aircrewremembered.com/KrackerDatabase/.

the next month's data set (provided the war has not yet ended). We count these exits as casualties. Spot checks suggest that the vast majority of cases so identified do indeed reference pilots who were either killed or severely wounded.

D. Pilot performance

The German air force in WWII counted among its ranks the highest-scoring aces of all time. During the war, 409 pilots scored 40 or more victories: 379 were from Germany, 10 from the Soviet Union, 7 from Japan, 6 from Finland, one from the United States, and one from the British Commonwealth. The best-scoring fighter pilot in history was Erich Hartmann, who had 352 aerial victories. The highest-scoring non-German ace was Ilmari Juutilainen from Finland, with 94 victories; the best-performing Soviet, Commonwealth, and American pilots were credited with (respectively) 66, 40, and 38 kills. Figure 2 plots the distribution and nationality of WWII aces.

[*insert Figure 2 about here*]

The high concentration of aces in the German air force reflects three factors, of which the first was its "fly till you die" rule. While Western air forces rotated pilots out of active duty after a fixed number of sorties, German pilots continued to fly until they were shot down.[13] Second, the poor quality of planes and training in the USSR at the start of WWII gave German pilots great opportunities to rack up victory claims. Third, German pilots had much greater experience vis-à-vis enemy air forces during the conflict's early stages, a result of their participation in the Spanish Civil War (Bungay 2001).

Altogether, German air force records document 53,008 aerial victories. These are credited kills, not simply claims. In an average month, the average German pilot scored 0.55 victories and faced a 3.4% risk of exiting the sample permanently (which was practically synonymous with death). In the East (resp., West), the victory rate was 0.97 (0.32) and the exit rate 0.029 (0.037). In other words, the exchange ratio (the number of enemy planes shot down before a pilot was lost) was 33 in the East and 8.6 in the West.[14]

The distribution of scores was extremely uneven. The top-scoring 110 pilots achieved as many aerial victories as the bottom 4,900 pilots combined. In an average month, the vast majority (more than 80%) of pilots failed to score even a single victory. At the same time, other pilots quickly notched up large numbers of victories: Emil Lang

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[13] The number of total sorties is a key factor in skewing the distribution of victory scores (Neillands 2001).

[14] Ours is *not* the standard definition of the exchange ratio, which normally measures either planes for planes or pilots for pilots. Here we calculate the number of enemy planes shot down in exchange for every pilot lost.

shot down 68 enemy planes in October 1943, and Hans-Joachim Marseille scored 17 victories in a single day (September 1, 1942). Figure 3 graphs the number of monthly victories per pilot by the quantiles of the distribution.

[*insert Figure 3 about here*]

There was a large seasonal component to air combat. The summer season – when ground operations were common and hours of daylight were long – also saw substantial spikes in aerial activity; the winter months brought a lull in fighting. Figure 4 plots the mean victory and exit (death) rates over time. The time-series peaks mostly coincide, except for the end of the war when the victory rate plummeted and the exit rate spiked.

[*insert Figure 4 about here*]

E. Organization and training

The Luftwaffe was divided into air fleets (*Luftflotten*), each of which was responsible for a particular geographical area. The number of fleets rose from four to seven during World War II. Air corps within each air fleet controlled the planes and men; air "districts" were responsible for infrastructure.

The air corps consisted of wings (*Geschwader*) of approximately 100 planes each. The wings were organized by function, with different *Geschwader* for fighter planes, long-range bombers, dive bombers, reconnaissance, and so forth. Each wing contained several groups, all dedicated to the same specialized function.

There is no evidence that better graduate of the air combat schools were sent to elite squadrons. Allocation of new pilots to units was largely random, driven by operational needs, recent losses, and – sometimes – personal connections (Caldwell 1996). Pilots were trained to fly before they received training in more specialized skills such as aerial combat. They would first attend "boot camp", which emphasized physical fitness and military discipline. After some basic training in aeronautics, they would then move on to an elementary flying school. Once they had their pilot's wings (after 100–150 hours), prospective fighter pilots were sent to air combat schools. Upon completing that course, the pilot would be attached to a squadron or group in an operational training unit at the front. The plan was for them to learn from experienced pilots before transferring to actual combat. Yet often – and especially as Germany's war situation worsened – training units were quickly sent into battle. By 1943, newly trained German airmen received markedly fewer training hours than their Western counterparts (Murray 1996).

III. MAIN RESULTS: INDIRECT EFFECTS OF PEER RECOGNITION

In this section, we examine how recognition of outstanding performance influenced the monthly victory score of peers. We define peers as pilots who are of similar quality, who served together, or who hail from the same regions.

A. Results by pilot quality

We first examine whether a good pilot being recognized via mentioning in the *Wehrmachtbericht* changed the performance of other "good pilots" during the same month. For that purpose, we estimate the following equation

$$vic_{i,t} = C + \beta \cdot Mentionp_t + \gamma \cdot P_i + \delta \cdot P_i \cdot Mentionp_t + \tau \cdot X'_{i,t} + \epsilon_{i,t} \quad (1)$$

Here $vic_{i,t}$ is the victory score of pilot i at time t, *Mentionp* is an indicator variable set equal to 1 if a Luftwaffe pilot is mentioned in the bulletin during month t (and set to 0 otherwise), P_i is the "performance bracket" to which a pilot belongs (i.e., bottom 80th percentile, 80th–90th percentile, 90th–95th percentile, 96th–99th percentile, topmost percentile), X' is a set of controls, and δ is the variable of interest – namely, the term for the interaction between pilot quality and the period with a pilot mention. We control for pilot experience, aircraft type, front, and for the possibility that the month of mention was itself unusual. We are interested in the interaction δ between the pilot quality percentile dummy P_i and the mention period dummy *Mentionp*. If δ is large and significant, then pilots in bracket P_i scored more during a month in which one of their fellow pilots was recognized (the mentioned pilot is excluded from the data.)

Table 1 reports the results. We find that all highly-ranked pilots exhibit improved performance during periods when an ace is mentioned in the *Wehrmachtbericht* dispatches. The additional outperformance – that is, beyond their outperformance due to inherent higher quality – is substantial. Note also that the relative increase in performance is greatest for the highest-ranked pilots. For example, those in the upper 1st percentile increase their score in months of mentions by about two thirds of their average whereas pilots in the 90th–95th percentile increase their scores by about a fifth of their average.

[*insert Table 1 about here*]

At the lower end of the skill distribution we find that pilots (a) perform better overall during periods when aces are mentioned but (b) underperform relative to higher ranked-pilots during mention periods.[15] In Section D, we document that the exit rate of low-ranked pilots increased sharply during periods when peers were mentioned.

[15] To see this, note that the mention period effect is positive and also larger than the interaction effect. Average pilots perform less well than top pilots in average months, and that difference grows in months of mentions – with the net effect still positive.

B. Past peers

The definition of fellow pilots in Table 1 is based on performance tiers only. The key threat to identification is that the returns to being highly skilled (or extremely risk tolerant) may be strongly time-varying. Skilled pilots may all do well in a particular month, resulting in a high number of victories – with one pilot then being mentioned in the daily bulletin in the same month.

[*insert Figure 5 about here*]

Figure 5 illustrates our identification strategy. Instead of calling everyone a peer who flies at the same time and then distinguishing them by their rank in the quality distribution, we focus on pilots who flew with the mentioned pilot in the past but have since been posted to another unit. Figure 5 presents the example of two pilots: Günther Rall, one of the highest-scoring aces of World War II; and Karl Gratz. From Autumn 1941 until March 1943, they served together in Squadron 8 of Fighter Wing 52. Rall remained with the squadron when Gratz was transferred to the command squadron ("Stab") in Group II, Fighter Wing 2. Eventually Rall was moved to the "Stab" of Group III, Fighter Wing 52. In August 1943, Rall was mentioned in the *Wehrmachtbericht*. We therefore classify Gratz as a "past squadron peer" and compare his performance in the month of Rall's citation with other months.

Because we focus on past peers, our strategy has the advantage of being uncontaminated by correlated shocks (e.g., a major offensive, good weather) that could increase victory scores for everyone in the same unit. We estimate

$$vic_{i,t} = C + \beta \cdot Mentionp_t + \gamma \dot{P}astpeerX'_{i,t} + \delta \cdot Pastpeer_{i,t} \cdot Mentionp_t + \tau \cdot X'_{i,t} + \epsilon_{i,t} \quad (2)$$

where $Pastpeer_{i,t}$ is set to 1 if pilot i was a former peer of the pilot(s) mentioned at time t (and is set to 0 otherwise). For example, for Karl Gratz, Pastpeer equals unity for August 1943, when Günther Rall is mentioned in the Wehrmachtbericht. PastpeerX' is a set of dummy variables – one for each eventually mentioned pilot – indicating whether pilot i ever flew with a mentioned ace in the past. In the case of Rall, this variable equals unity for all pilots who had flown with him in different squadrons previously, even before August 1943. This allows us to control for pilots with peers potentially being of a higher average quality. In the aggregate, pilots who are peers of mentioned pilots do not perform notably better or worse than those who never flew with mentioned pilots (see Figure A5 in the Appendix). We again exclude pilots in the same squadron at the time of the mention.[16]

[*insert Table 2 about here*]

[16] Peers of the pilots mentioned in the *Wehrmachtbericht* do not always outperform, as the distribution of fixed effects makes clear (see Figure A4).

Table 2 shows first that past peers from the same squadron reacted strongly during periods when a former comrade is mentioned in the *Wehrmachtbericht.* The variable's significance survives adding a large set of controls as well as squadron and time fixed effects (columns 2–4).[17] Using the most demanding specification, we check to see if pilots in the same group also exhibited a bump in performance. Recall that "groups" were larger units comprising three or four squadrons; they often (but not always) operated from the same airfield. We find outperformance also for former "group peers", but the effect is smaller. Finally, we form even broader comparison groups by tracking the location of every airfield from which German fighter units operated during World War II (Appendix figure A2); we then use this information to create a dummy variable for "base peers". Many such peers would have been in the same group, yet also other groups would sometimes have operated from the same airfield. We continue to find an effect but again it is smaller. As the intensity of (past) interaction declines, our regressions indicate progressively weaker effects from a mention in the daily bulletin.

Our initial analysis suggested that outperformance amongst former peer was heavily concentrated amongst the highest-performing aces. We now subdivide our sample into three groups – those below the 80th percentile of victories, those above the 80th, and alternatively, above the 90th percentile. Table 3 reports the results. There is only a small and insignificant coefficient for former peer mentions for the bottom 80% of the sample – equivalent in size to about half of the Eastern front dummy. The top 20% of pilots show outperformance by 0.76 victories in the month a former peer gets mentioned; this is equivalent to a 70% boost relative to the baseline rate of scoring (on the Western front). For the top 10%, effects are even larger. The more demanding difference-in-difference specification for former peers thus confirms the results from Figure 1 – it is the top aces who react most strongly to another pilot being publicly recognized.

[*insert Table 3 about here*]

C. Birthplace peers

We interpret the effects of peer recognition as being driven by a desire to "keep up" with one's peers. In other words, the increase in the number of victories is compatible with an interpretation that emphasizes status competition.

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[17] In Table A1, we useeven more demanding specifications. Column 2 reports results with pilot fixed effects instead of the PastpeerX' set of dummies; results are almost identical. Column 3 uses past squadron fixed effects, and column 4 intreacts squadron and time fixed effects. The magnitude of results is largely unchanged.

To examine further whether such status competition could reasonably explain our findings, we test to see if those born in nearby towns react more strongly to a mention in the dispatches. We were able to determine the birthplaces of 352 aces. We already know that, among aces, the average score and the incremental effect of a peer mention is relatively large. But how much greater is the increase in the number of victories when a pilot from the same region is mentioned? While not every high-performing ace knew every other ace, many of them would have been familiar with each other's careers and background. In addition, last names often contain information about regional origins.

[*insert Figure 6 about here*]

Figure 6 shows that, for pilots born close to each other, the effect of a mention in dispatches is especially large.[18] At a distance of less than 100 miles, the peer-induced boost during mention months amounts to more than 4 extra victories. Yet at a distance of (say) 400 miles, the performance bump amounts to only two additional victories.[19]

D. Risk

Fighter pilots faced high risks. Every aerial victory came at the risk of death. We do not have exact data on casualties, but we can construct a proxy based on exit from our sample. In those cases where it was possible to check (i.e., the subsample of 352 aces for whom we have additional information), the pilot was killed in almost every case. Any analysis of the Luftwaffe incentive system must consider both dimensions: the number of *enemy* fighters downed and the number of *own* men lost.

To examine these effects, we repeat the analysis from Tables 2, using risk of exit from the sample as our dependent variable. We employ survival analysis by performing Cox regressions on the data. Table 4 reports the hazard ratios for pilots conditional on the mention (in the *Wehrmachtbericht*) of a past squadron peer. Experience has only a limited effect on exit rates. On the Eastern Front, the death rates are clearly much lower.

[*insert Table 4 about here*]

For the sample as a whole, we find a markedly higher coefficient during periods with such mentions; in fact, the risk of exit is twice as high. This effect is even greater for pilots below the 80th percentile of average performance (column 2), with an increase

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[18] We use the simple specification from Table 2, column 1 because our sample is small.

[19] Overall levels are high because the small subset of 352 pilots with detailed biographical data is dominated by aces with very high overall performance. We also perform regression analysis to demonstrate the statistical strength of these findings. In Figure A.1 we plot the marginal effect of being a peer of a mentioned pilot in the month of the mention as a function of (the log of) birthplace distance, for four different specifications. In each case we obtain a clearly downward sloping pattern.

of 250%. According to the estimates with controls from Panel B, for pilots *above the 80th percentile,* there is a 25% increase in the hazard rate. For the best pilots (those at the 90th percentile or higher), the effect is even smaller (+1.5%) and not significantly different from zero.

The findings summarized in Table 4 put the results on performance improvement in context. Even though performance increased for pilots *on average* in months when a former peer was mentioned, that increase came at the cost of higher exit rates. This effect differs by pilot ability. Those below the 80th percentile of scores earned 0.1 *additional* victories during months in which a former peer is mentioned (cf. Table 1, col. 6); at the same time, their exit rate *increased* by a factor of more than 2. In contrast, top pilots (99th percentile or higher) earned 2.5 more victories during such months.

IV. Additional Results and Alternative Interpretations

We next attempt to rule out potential confounding mechanisms. In addition, we examine the robustness of our findings.

A. Correlated shocks

A natural confounding factor is the possibility of unobserved and correlated shocks simultaneously affecting the outcomes of different peer groups. To deal with the most likely correlated shocks, we focus on peers who are *not* part of the same squadron when measurements are made. This approach deals with contemporaneous, squadron-level shocks; however, we must still consider whether other omitted variables could be driving the results.

One direct way of addressing the risk of correlated shocks is to see if our findings hold when pilots from nearby units are excluded. For this purpose, we impose a minimum distance requirement for the airfields from which pilots' squadrons operated. During World War II, German forces were fighting from the Arctic Circle to the deserts of North Africa and from Stalingrad to the Spanish frontier with France. The minimum distance between air fields in our data is 9 miles; the maximum, 2,600 miles (see Figure A2).

Having imposed minimum distance requirements on our data, Figure 7 gives the coefficients on the former peer interaction variable as those requirements become increasingly stringent. A distance of even 100 miles usually corresponded to a marked change in combat conditions (for example, the northern and southern sectors in the battle of Kursk and Orel were approximately 100 miles apart). At a distance of 500 miles, units would be operating with different army groups (North, Center, or South) on the Eastern Front. Units flying bomber intercept missions over Germany were separated by up to 1,000 miles from their counterparts on the Eastern Front.

[*insert Figure 7 about here*]

Figure 7 demonstrates that the coefficient for outperformance becomes greater as we impose increasingly stringent distance requirements.[20] This tendency holds for squadron peers, group peers, and (to a lesser extent) base peers. These results strongly suggest that our results are not driven by correlated shocks.

Another issue is possible confounding by differential but correlated upgrades in aircraft equipment. Since aerial combat performance depends not only on pilot ability but also on equipment quality, it follows that changes in performance could reflect changes in planes. Thus a sudden increase in the number of aerial victories could be driven by aces receiving nearly simultaneous upgrades in the planes they piloted.

However, that mechanism does a poor job of explaining our results. We have information on the type of aircraft used for 83,000 of our total 96,000 observations (see Figure A3 for the distribution of aircraft types used). Most missions were flown in one of just four aircraft types – the BF-109E, F, and G and the FW-190 – which together accounted for 86% of all aircraft types used.

Did correlated upgrades of equipment across former peers contribute to the increase in performance during mention months? This is unlikely. The Luftwaffe often upgraded entire squadrons to facilitate maintenance and training. Its usual procedure involved squadrons being recalled to Germany, re-equipped, and then sent back to the front. There is no anecdotal evidence of aces being given special treatment. To the contrary, at least one ace (Hans-Joachim Marseille) was forced to pilot an "upgraded" BF-109G – despite his protests – because his entire squadron was being re-equipped. Marseille died shortly thereafter when the more powerful but unreliable new engine failed on one of its first missions.

Furthermore, we directly control for the effect of aircraft type. The results reported in Tables 1–3 are from regressions that include dummy variables for the different types of aircraft. Any systematic increase in performance as a result of aircraft upgrades should be captured in our data. Finally, we check to ensure that the probability of flying a similar type of aircraft is not systematically higher in months during which an ace is mentioned in the *Wehrmachtbericht*. This is not the case.[21]

B. Social learning

One potential concern is a general co-movement of scores among pilots who belonged to the same squadron in the past. Suppose that pilots learned some specific skills from other pilots or in special circumstances in their area of operation while

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[20] We use the stringent specification from Table 2, column 4. If we use the simpler baseline specification with few controls (column 1, as for Figure 6), results are nearly identical.

[21] Results available upon request.

previously flying together, and assume that skill became especially useful in some later period. If outstanding pilots do so well that they are mentioned in the daily bulletin, then also other pilots with whom they trained – or who developed similar skills in the same environment – might likewise do better. In that event we would find higher performance by past peers in periods when aces are mentioned in the daily bulletin; yet the reason would be correlated on-the-job learning rather than motivation effects.

We do not believe that this mechanism, either, is likely to drive our findings. In the first place, our results in Table 2 already control for whether pilots ever served together in the past. This allows for general spillovers from the mentioned pilot to his former peer in all quiet periods, i.e. those without a mention. Also, note that fixed effects of having flown with an ace are not uniformly positive (see Figure A4): Some 44% of mentioned-pilot fixed effects are negative. There is no evidence that those who flew with later-mentioned pilots are themselves noticeably better pilots.

One remaining possibility is that, by flying together, pilots picked up skills that become useful in particular, novel situations. A pilot with a good enough month to be mentioned in dispatches may have had many former peers who could similarly exploit the skills jointly acquired in the past. Instead of estimating a level difference for pilots who are former peers, we allow for co-movement of victory scores of pilots in different squadrons if they flew together in the past, and ask whether this co-movement strengthens during months when a former peer is mentioned. In this way, we allow the payoff from joint experience to be time-varying, as it should be if different combat conditions reward particular skills differentially.

To examine this question empirically, we first restrict the sample to former peers – that is, all pilots who flew at some earlier time with a pilot who is mentioned in a WWII daily bulletin. We then regress the log of victories by pilot i (+.01) on the log of victories of the mentioned pilot m (+.01), to allow for a direct estimation of the performance elasticities as follows:

$$\log(vic_i + .01) = C + \alpha \cdot \log(vic_{mi} + .01) + \beta \cdot M_{mi} + \gamma \cdot M_{mi} \cdot \log(vic_{mi} + .01) + \delta \cdot X' + \varepsilon. \quad (3)$$

In this expression, C is a constant, α measures the correlation of victory scores between pilot i and his dispatch-mentioned peer m, β is the average change in (log) victories in a mention month for pilot m, and γ is the coefficient of interest – for the change in the co-movement between pilot i's victory score and that of his mentioned former peer. There is a high bar for validating this hypothesis: there must be an increase in the correlation during the mention period. Any pilot cited in the *Wehrmachtbericht* must by definition have had an exceptionally good month. So for his former peer to exhibit an even greater victory score correlation during mention periods would require a dramatic change in the latter's fortunes.

[*insert Table 5 about here*]

That is exactly what Table 5 reports. In non-mention periods, there is co-movement between the victory scores of former squadron peers. The correlation is 0.114; in mention periods it is 0.18, or more than 50% higher (column 1). This effect holds also when we control for front, experience, and aircraft type (column 2) as well as for time fixed effects (column 3). The results in column 3 indicate that the correlation during mention periods is stronger, by a factor of more than 2, than the correlation during quiet periods. After excluding pilots from the same group (because they might be subject to correlated shocks), we find a strong co-movement during mention periods but only a small and negative baseline correlation (column 4).

C. Learning about one's own ability versus status competition

Pilots who knew that their former peer had just been recognized may have updated their beliefs about their own skill and potential – and all the more so if they viewed the mentioned pilot as someone similar to themselves. These pilots might then exert more effort and/or take more risk, which would result in time-varying correlation in victory scores but *not* because of status concerns.

We consider this to be an unlikely account. We tackle the problem empirically by separating our data into two categories: mentions of a former peer whose monthly victory score exceeds the treated pilot's own past performance, and those that had never scored so much in a single month. For instance, when Rall is mentioned with a monthly score that far exceeds Gratz's, the latter may be learning about his own type. However, if in August 1943 (the month of Rall's *Wehrmachtbericht* mention) Gratz had already scored as much as Rall had, then it is more likely that status competition motivated Gratz to do better.

[*insert Table 6 about here*]

The results of this comparison are reported in Panel A (columns 1 and 2) of Table 6. The spillover effect is strong in the group of pilots who had already performed at the same level, with large and significant coefficients at the squadron, group, or base level. Amongst pilots who had never performed at the same level, results are insignificant, and two of the three coefficients are even negative. This leads us to conclude that learning about one's own type is not the main channel for our results.

D. Placebo tests and Monte Carlo simulations

The statistical properties of our estimators certainly merit further attention. Both squadron membership and victory scores are observed with error, and our coding of the former affects the explanatory variable because we form peer groups based on who previously flew with whom.

We perform two exercises to address potential concerns. First, we generate "fake mentions" for pilots who satisfy performance criteria that are similar to pilots who are actually mentioned in dispatches. Our fake-mention dummy is set equal to 1 only for pilots who had more than 59 victories *and* had scored either (a) more than 11 victories in a single month or (b) a "round number" of victories (100, 150, 200, 250, 300). We chose these cut-offs based on the average characteristics of mentioned pilots.

The results of this test, under the most rigorous specification, are reported in column 5 of Table 5. The coefficient for placebo mentions is actually negative but insignificant. Table A2 (in the Appendix) gives results for all specifications. Although some of these are positive, none is significant. Importantly, once we exclude same group pilots (column 4), we find placebo effects that are very close to (and statistically indistinguishable from) zero.

We examine our estimation's statistical properties more broadly by performing some Monte Carlo exercises. We draw 0.01% of the observations randomly and designate them as placebo mentions. This procedure generates 93 instances, which is close to the actual number (84) of mentions. We use these faux mentions to code new peer variables and then run regressions of pilot performance against them (as in Table A1, column 2). This simulation is repeated 100 times, and the results are plotted in Figure A6. The size of the coefficients are skewed slightly rightward. The actual coefficient estimated in Table A1 (column 2) is larger than the fake one in 92 out of 100 cases, and the former's t-statistic is greater than that in 97% of all simulated cases. In short: although our data may exhibit some upward bias, we find no evidence – either from placebo tests or our Monte Carlo simulations – of our results being driven by such a bias.

E. Type of mention

Mentions in the *Wehrmachtbericht* came in different types – mentions for high cumulative accomplishments, for achieving a round victory score (like 100, 150, 200, etc.), or for an unusually high score in a short time period like a day, a week, or a month. Only 15 mentions are for pure "flow" mentions, 55 are for "level" mentions (round or cumulative), and 13 combine both elements.

If high-performing aces were motivated by status competition, we would expect all of these types to have an effect. However, competing for a high cumulative score or a round number of victories will have less of an immediate effect in our data than to aim for a high rate of victory over a few days or weeks.

In Figure A7, we plot outperformance results for each mention type. The coefficients are plotted for the specification from Table 2 column 4 including a full set of fixed effects. Flow mentions give the largest effect, but coefficients are not different from each other.

F. Results by front

Next we see whether results are similar for the Eastern Front and the Western Front. In Panel A of Table 6, columns 3 and 4 report coefficients for the various categories of peer *by front*. There are positive coefficients in both theatres of combat operations for squadron and group peers, but those for the Western Front are uniformly lower – and not significant at conventional levels. For "past base" peers we find a negative results. Subdividing the sample reduces sample size, which inevitably leads to lower significance. If we simply use the estimated mean effects, effects in the West are somewhat smaller but not dramatically so. For squadron peers, background performance was 0.98 and 0.33 victories in the East and West, and outperformance in months of peer mentions 0.55 to 0.09, meaning that the boost was on the order of 55% in the East and 27% in the West. The smaller and insignificant result in the West probably also reflects differences in combat conditions. German air superiority was never re-established in the West after the Battle of Britain, but it prevailed for a long time in the East. That may have given high-performing pilots greater degrees of freedom to increase their score in the West.

G. Officers' versus other pilots' reaction

Status is a multifaceted concept. It is not clear ex ante if higher-status pilots should react more or less (than other pilots) to a former peer being recognized. In Panel B of Table 6, columns 1 and 2 report results when our main analysis is replicated while grouping the sample into officers versus non-officers.[22] We find that officers in general show very similar performance increases when a former peer is mentioned in the daily bulletin. The difference in coefficients is 0.35 versus 0.3. For group peers, results also look very similar. Finally, we find that non-officers who shared a base with a mentioned pilot in the past seem to react more strongly, but coefficients are not statistically different from each other.

Officer status mainly reflected a difference in social background, education, and career choice. One possible interpretation is that spillovers were similar for officers and non-officers suggest a relatively egalitarian environment – amongst fighter pilots, status was predominantly defined by combat performance (Galland 1993).[23]

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[22] Contrary to the practice in the USAAF, German pilots were not all officers.

[23] The lack of differences in the effects for the two groups might mask other, potentially counterbalancing, sources of heterogeneity, such as individual concerns about relative status or differences in average skill by rank.

H. Stability by period

Next, we split the data set into observations before and after August 1942, when the war was approximately half over (month 35 of the 69 in our data). August 1942 is also close to the war's turning point.

In Panel B of Table 6, columns 3 and 4 replicate our peer analysis for WWII's first and second half. During the first half, effects are smaller and less significant. One reason is that at first there are fewer observations of peers; as the war goes on, though, pilots accumulate more past peers and so our statistical tests become stronger. In fact, two thirds of our observations on peers of mentioned pilots are from the war's second half. We find that spillovers from peer recognition are more pronounced for the post–August 1942 period than for the full sample – a generalization that holds no matter which peer-group definition is used.

I. Lags and leads

It is crucial for our analysis that pilots do not react to their peers' performance *before* it actually occurs. Using lags and leads is a simple way to test the assumption of identical counterfactual trends for treatment and control pilots (Angrist and Pischke 2009). To test for pre-event trends and effects, we align observations in event time, so $t = 0$ is the time of peer mention, and we drop all observations of pilots who were never the peer of a mentioned pilot.

[*insert Figure 8 about here*]

Figure 8 plots average performance in event time. We distinguish between pilots above the 80th percentile and all other pilots. As clearly shown in the left panel of Figure 8, there is no positive trend among pilots *prior* to the mention of a peer. The same is true in periods *after* the peer's mention. Thus the only period that stands out is the one in which the mention occurs, where we see outperformance to the tune of 1.8 more victories per month by the best pilots. For pilots below the 80th percentile, as expected given the results in Table 3, we do not find a substantial jump in performance during the mention month relative to other months.

J. Effects by time since joint service

Our analysis is based on the assumption that pilots who served together in the past typically viewed themselves as peers. Such a bond should be relatively weak for those who flew together long ago; however, it should be stronger for those who recently shared the same officers' mess, commanding officer, and missions. To confirm that our hypothesized channel for differential outperformance is a viable one, we compare effect sizes as a function of how recently pilots served together.

[*insert Table 7 about here*]

In Table 7 we replicate the previous results for two subgroups: those pilots for whom more than the sample's median time (six months) had elapsed since joint service; and those for whom less time had elapsed. We find smaller effects for past squadron peers and past base peers who served together in the most distant past (but slightly larger effects for past group peers). Although the differences in magnitude are not significant, the results for squadron and base peers are in line with our hypothesis.

V. CONCLUSION

Social comparisons can demotivate employees, leading to lower job satisfaction and higher quit rates (Card et al. 2012). There is also strong evidence that status competition is a potent force in human behavior, especially when it comes to consumption (Kuhn et al. 2011; Bertrand and Morse 2016).

Our paper explores whether status competition can induce greater effort and more risk taking in a high-stakes setting. Using data from the German air force during World War II, we focus on pilots who flew together and were then assigned to different squadrons. When one of them is mentioned in the daily bulletin of the German armed forces for his outstanding accomplishments, former colleagues on average exert more effort and score more victories. The effect varies by skill group: performance gains are concentrated among highly skilled pilots; and though average pilots also score more, their gains are relatively small.

An important finding is that risk increased significantly for the low-skilled pilots: unlike high-skilled pilots, they die at a higher rate following the official recognition of a peer. Our findings suggest that status competition can be a key motivator for individuals in a high-risk setting with severe principal–agent problems. Yet high-powered incentives can backfire, possibly reducing efficiency in contexts where risk matters.[24]

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[24] A full accounting of the overall efficiency effect would have to take into account the cost of training replacement pilots, their (time-varying) quality, and the aggregate impact of engineering a culture where status was closely tied to aerial victories. Neither parameter can be pinned down by our analysis.

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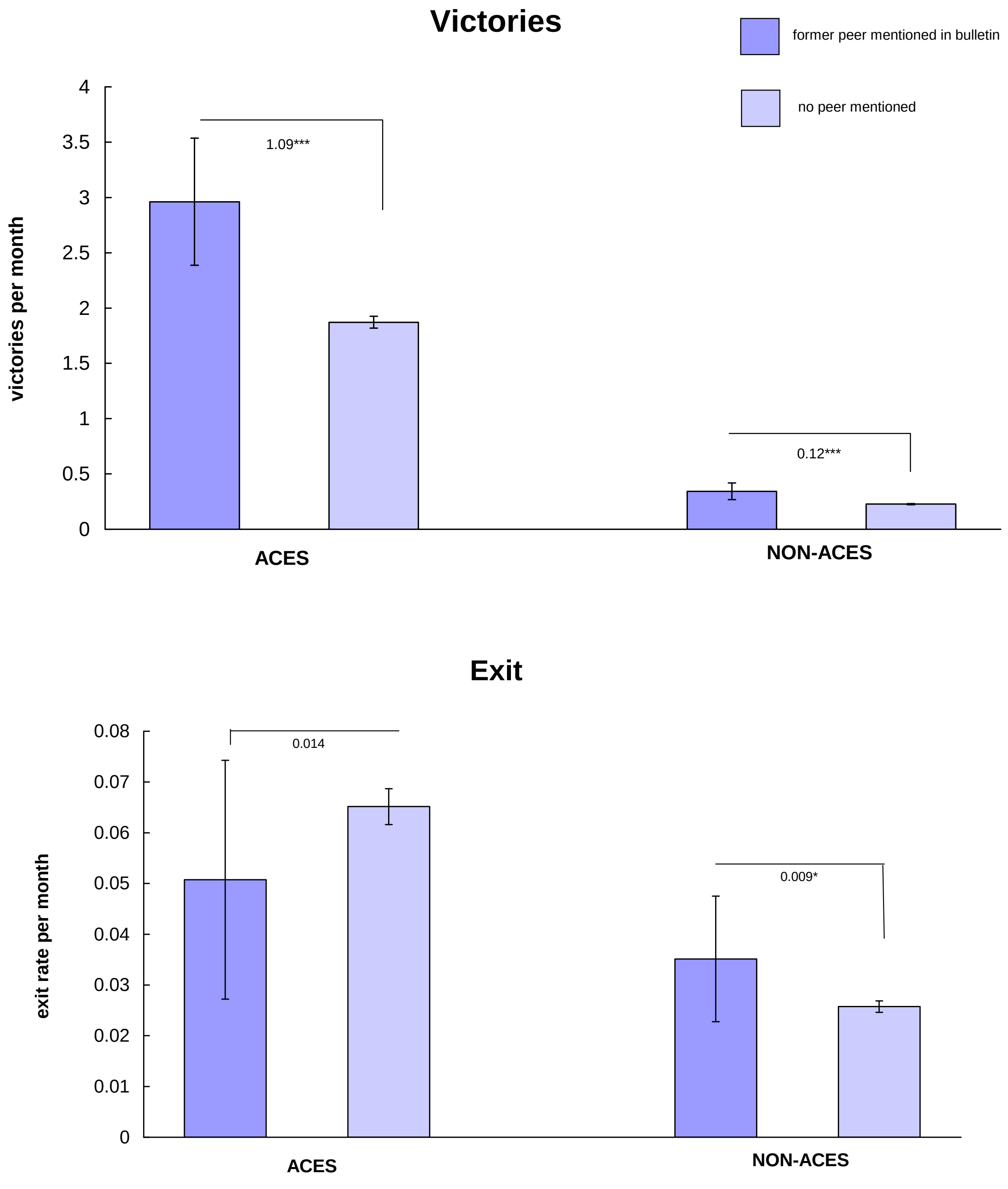
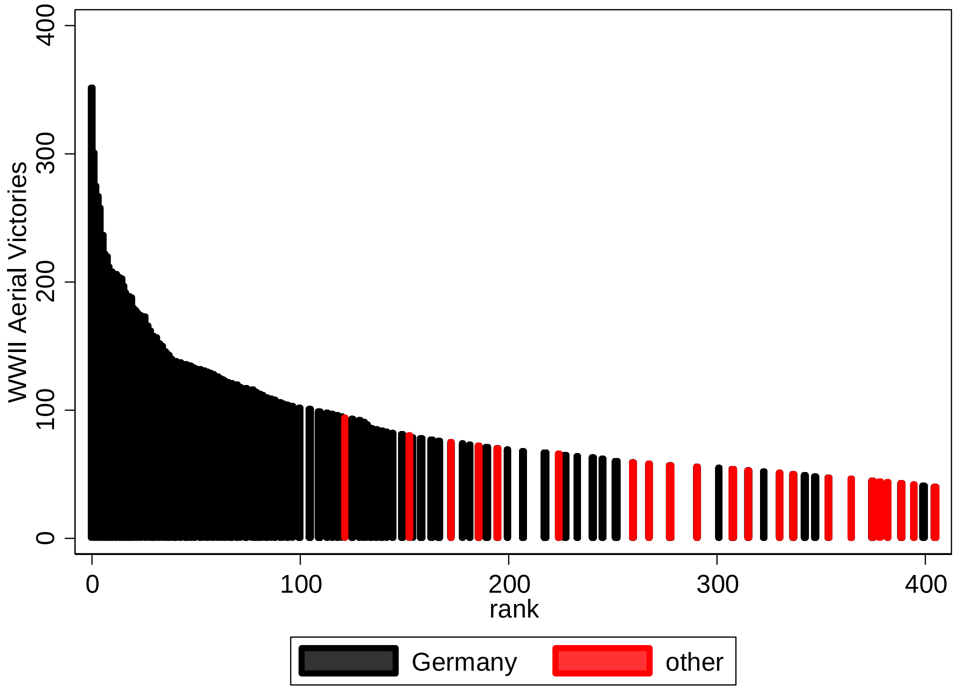
FIGURES

Figure 1: Victory and Exit Rates per Month for Fighter Pilots (Aces and Non-Aces) during Periods of Fighter Pilot Mentions



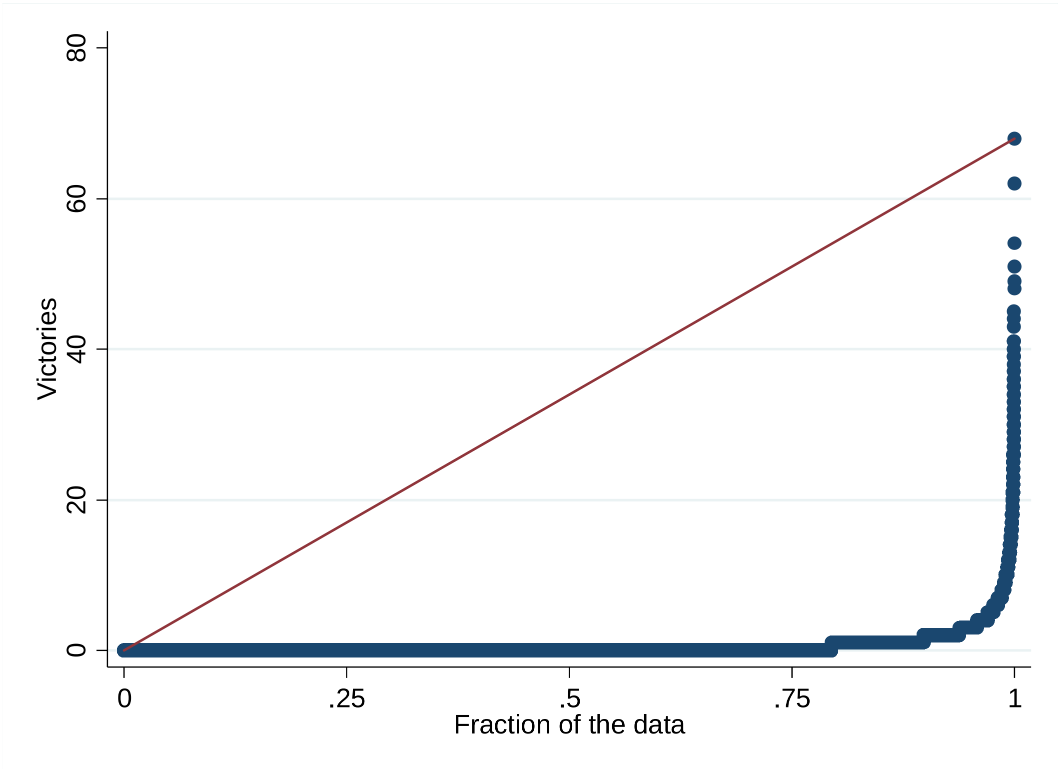
Note: The figure shows mean monthly victory and exit rates for aces and non-aces (without any additional controls). Aces are defined as being in the top 20% of the average monthly victory rate during all of World War II. Pilots are "former peers" if they previously flew in the same squadron as a pilot mentioned in the German armed forces daily bulletin (*Wehrmachtsbericht*) but no longer do at the time of mention.

Figure 2: Aerial Victories – Total for WWII by Rank



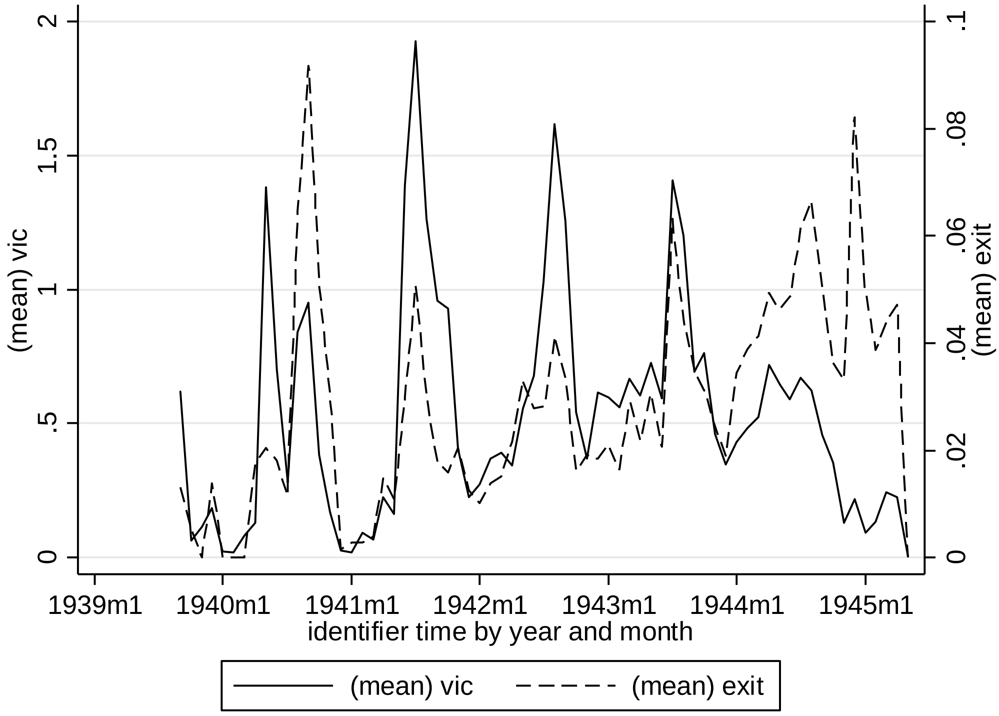
Note: The figure shows the overall score, by pilot, for pilots ranked 1 through 400 during World War II. The gaps signify ties.

Figure 3: Cumulative Distribution of Monthly Victory Scores



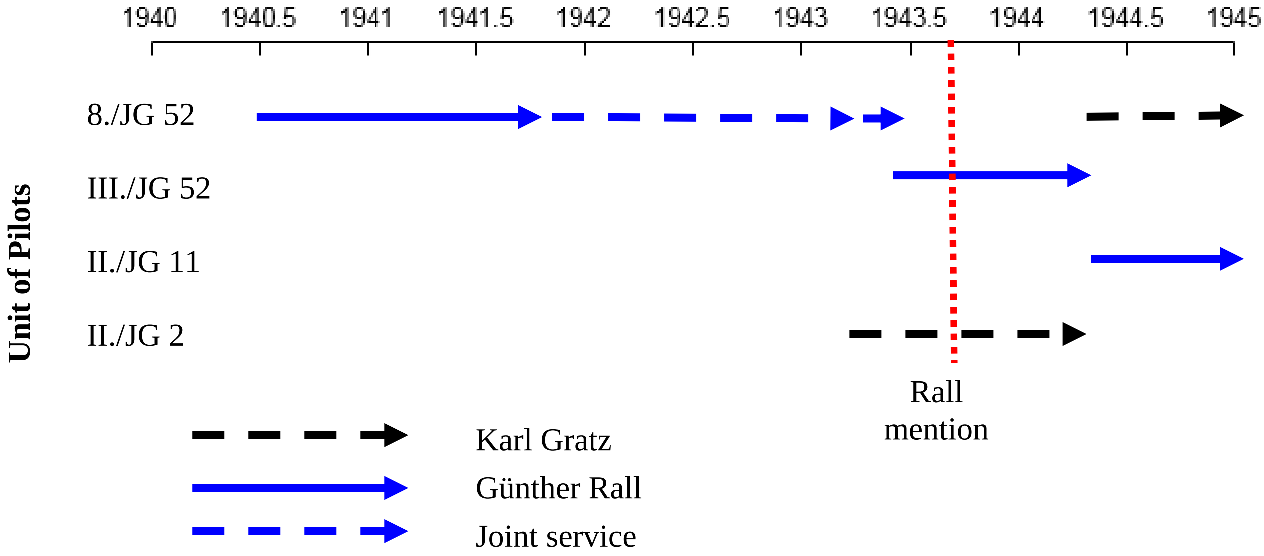
Note: This figure shows the cumulative distribution of monthly victory scores by German pilots in our data set during all of World War II.

Figure 4: Mean Victory Rate per Pilot and Month from September 1939 through April 1945



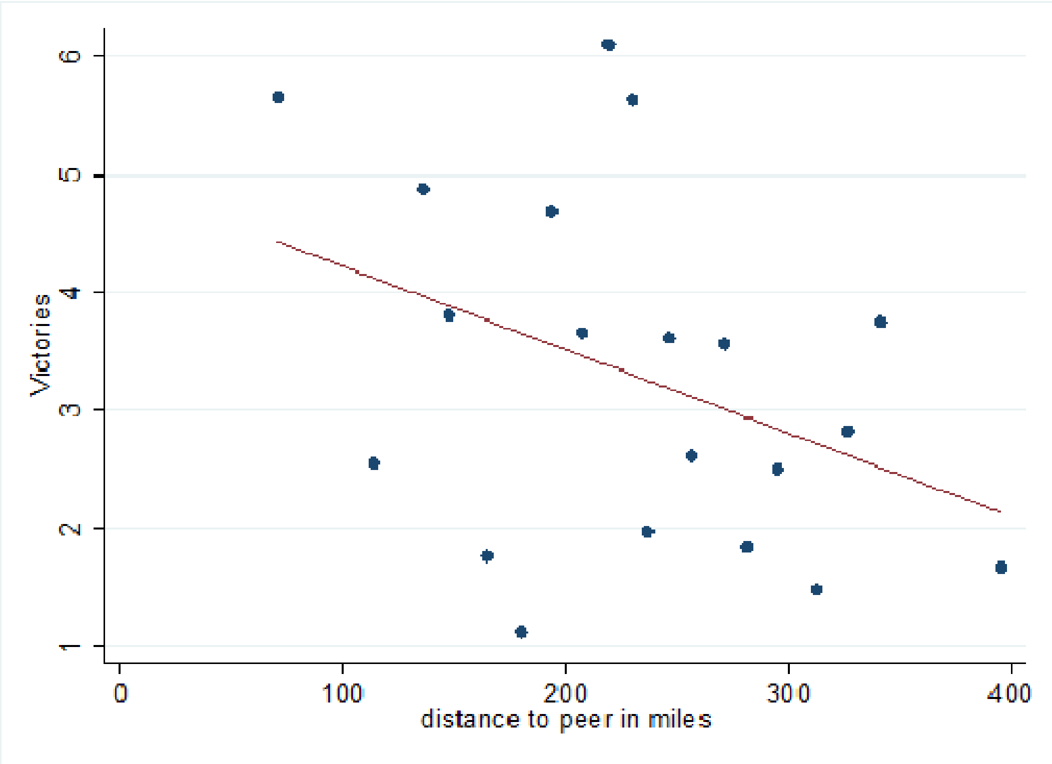
Note: The figure plots the per-pilot average monthly victory score (left-hand *y*-axis) and the exit rate per month (right-hand *y*-axis) over time (*x*-axis).

Figure 5: Identification strategy.



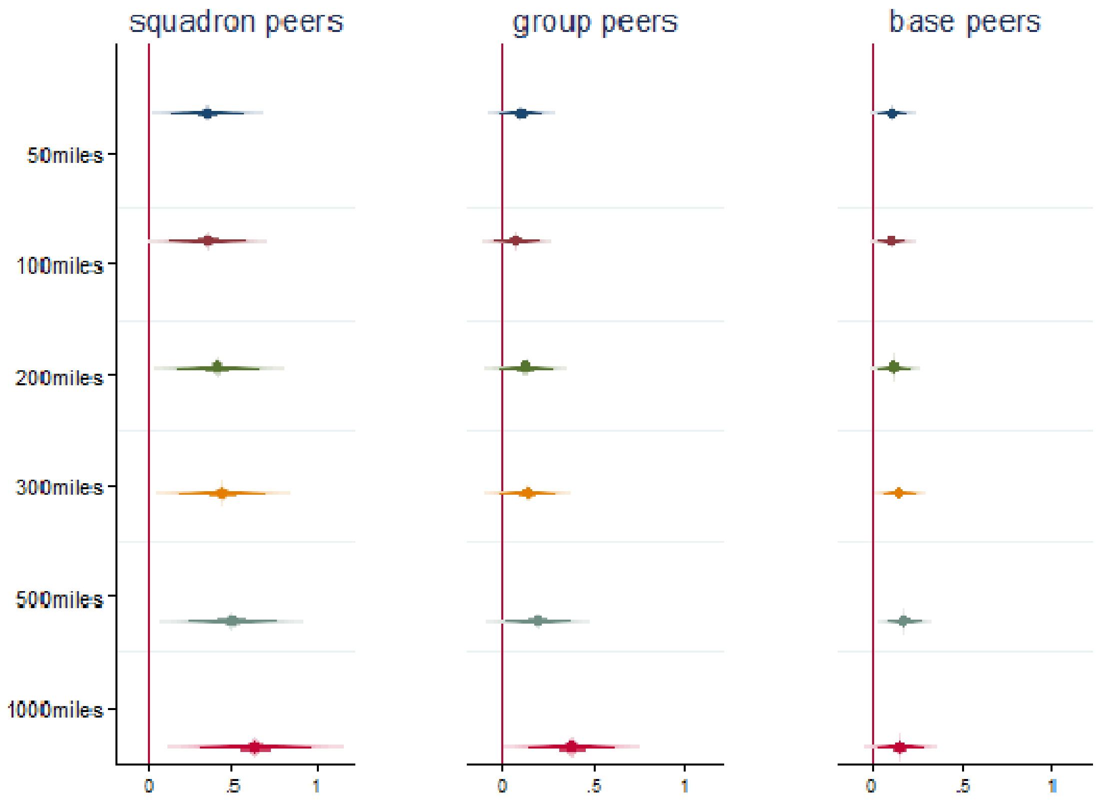
Note: red dashed line indicates mention in the *Wehrmachtbericht* for Günther Rall

Figure 6: Victory Score during Mention Periods (Past Squadron Peers Only) As a Function of Birthplace Distance



Note: The figure shows a binscatter of the number of additional victories of peers of a mentioned past peer, during mention periods of that particular pilot, as a function of birthplace distance (mentioned pilot *minus* pilot in question). Past peers are former squadron peers who are no longer serving in the same unit. The underlying specification is identical to the one used in Table 2, column 1. The analysis is based on data from 352 aces for whom birthplace location is available.

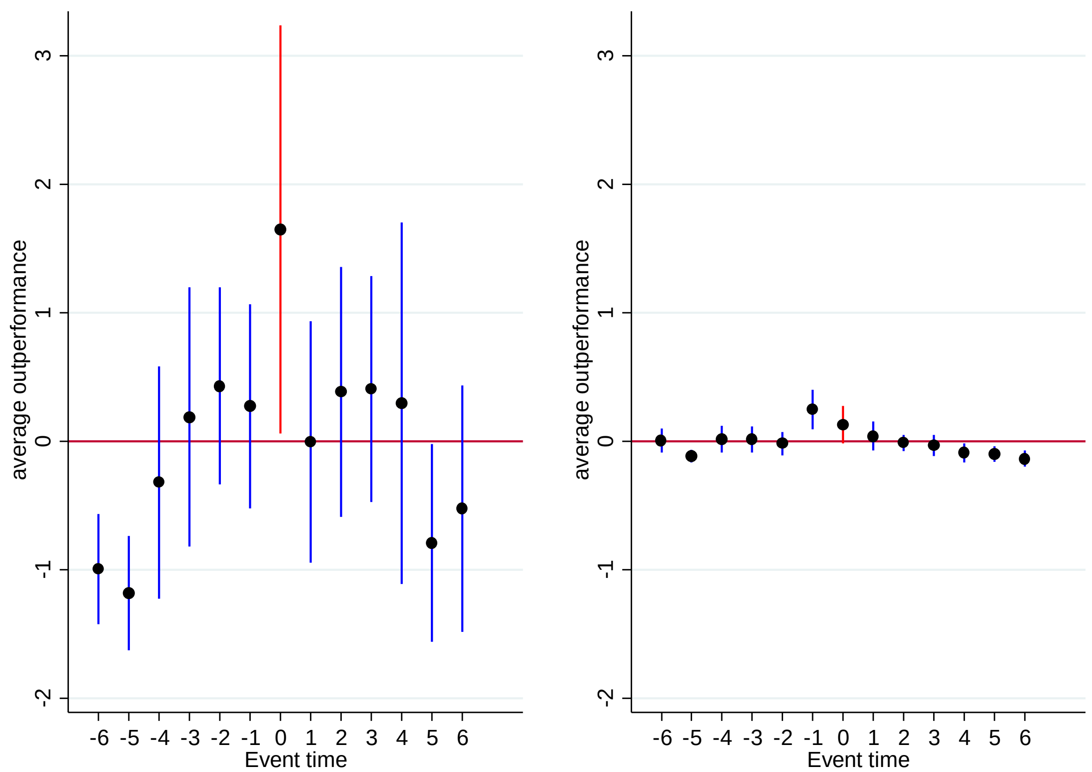
Figure 7: Peer Effects by Minimum Distance



Note: The figure plots the coefficient for outperformance (x-axes) during mention months – of the peers of mentioned pilots – as a function of minimum distance (y-axes) for squadron, group, and base peers. It uses the same specification as Table 2, column 1.

Figure 8: Pilot Outperformance in Event Time by Quality Group

Panel A: Top 20% **Panel B: Bottom 80%**



Note: Each panel plots the coefficient for outperformance of past peers of a mentioned pilot in event time (the pilot's mention in the *Wehrmachtbericht* corresponds to $t = 0$). The left (right) panel shows results for past peers in the top 20% (bottom 80%) of overall performance as defined by average monthly victory scores. Period of mention highlighted in red.

TABLES

Table 1: Percentile of Pilot's Rank and Mention in Dispatches of Other Pilots – By Overall Performance

	(1)	(2)	(3)	(4)	(5)	(6)
Percentiles:	p99+	p95-99	p90-94	p80-89	p90-100	p0-80
Mention period	0.187***	0.157***	0.123***	0.090***	0.128***	0.699***
	(0.017)	(0.013)	(0.010)	(0.007)	(0.010)	(0.077)
Pilots nth pcn	3.373***	1.891***	1.018***	0.672***	1.644***	-1.195***
	(0.378)	(0.138)	(0.069)	(0.036)	(0.097)	(0.062)
Mention period x Pilots nth pcn	2.560***	0.948***	0.544***	0.292***	0.890***	-0.602***
	(0.528)	(0.190)	(0.098)	(0.046)	(0.127)	(0.075)
Eastern Front	0.513***	0.357***	0.224***	0.128***	0.363***	0.364***
	(0.039)	(0.027)	(0.020)	(0.013)	(0.027)	(0.026)
Experience	-0.004***	-0.004***	-0.004***	-0.005***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
Constant	0.233***	0.219***	0.230***	0.203***	0.174***	1.295***
	(0.030)	(0.023)	(0.017)	(0.013)	(0.023)	(0.064)
N	96043	95076	91257	86283	96043	96043
R^2	0.101	0.112	0.084	0.089	0.150	0.136

Note: * p < .1, ** p < .05, *** p < .01. Standard errors in parentheses are clustered at the level of the squadron ("Staffel"). Mentionperiod is a dummy variable that takes the value zero if no Luftwaffe fighter pilot is mentioned in the *Wehrmachtsbericht* during a month, and 1 otherwise. Pilots nth pcn is a dummy for whether a pilot belongs to the n^{th} percentile (indicated by the column heading), capturing average outperformance by quality-percentile. We define pilot quality by ranking pilots based on their average monthly victory score during the entire conflict. Mentionperiod x Pilots nth pcn gives the outperformance of pilots in the n^{th} percentile during periods when a Luftwaffe fighter pilot is mentioned. Eastern front is a dummy for pilots serving on the Russian front. Experience is the number of months of wartime service since the start of World War II, beginning with the first victory claim in our records (except for veterans of the Spanish Civil War, for whom we add months of service there after the first victory claim). In col. (1) – (4), we exclude higher-ranked pilots from the comparison group. Example: In col (2), for pilots in p95-99, we compare pilot performance for pilots in the 95^{th} to 99^{th} percentile with pilots in the 0^{th} to 94^{th} percentile, but exclude the top 1%. In the next column, we drop all pilots ranked 95^{th} to 100^{th} percentile.

Table 2: Spillover Effects during Mention Periods

	(1) OLS	(2) controls	(3) +SqFE	(4) +TimeFE	(5) +TimeFE	(6) +TimeFE
Mention period	0.225***	0.206***	0.207***			
	(0.019)	(0.020)	(0.020)			
Past squadron peer of mentioned	0.465***	0.375***	0.365***	0.340***		
	(0.136)	(0.135)	(0.136)	(0.123)		
Past group peer of mentioned					0.122*	
					(0.068)	
Past base peer of mentioned						0.110**
						(0.045)
Eastern Front		0.601***	0.625***	0.543***	0.551***	0.550***
		(0.048)	(0.055)	(0.056)	(0.056)	(0.056)
Experience		-0.007***	-0.007***	-0.004***	-0.006***	-0.005**
		(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Constant	0.402***	0.258***	0.279***	-0.419***	-0.406***	-0.533***
	(0.021)	(0.033)	(0.040)	(0.061)	(0.059)	(0.077)
N	96043	96043	96043	96043	96043	96043
R^2	0.010	0.038	0.055	0.083	0.086	0.086

Note: * p < .1, ** p < .05, *** p < .01. Standard errors in parentheses are clustered at the level of the squadron ("Staffel"). Starting with column 2, dummy variables for aircraft type are included. Mentionperiod is a dummy variable that takes the value zero if no Luftwaffe fighter pilot is mentioned in the *Wehrmachtsbericht* during a month, and 1 otherwise. Past squadron peer is a dummy for pilots who, in the past (but not at the moment of the mention), served with the mentioned pilot in the same squadron ("Staffel"). Past group peers are pilots who served in the same group ("Geschwader") in the past, but not at the time of mention. Past base peers are all pilots who served in units flying from the same airfield as the mentioned pilot at any point in the past (but not at the time of mention). All regressions include individual dummy variables (PastpeerX') indicating whether a pilot had flown with an eventually mentioned pilots in the past. Eastern front is a dummy for pilots serving on the Russian front. Experience is the number of months of wartime service since the start of World War II, beginning with the first victory claim in our records (except for veterans of the Spanish Civil War, for whom we add months of service there after the first victory claim).

Table 3: Spillover Effects during Mention Periods – by Performance Subgroup

	(1)	(2)	(3)	(4)
Percentiles:	All	< 80	80+	90+
Past squadron peer of mentioned	0.340***	0.072	0.758**	1.350***
	(0.123)	(0.052)	(0.312)	(0.519)
Eastern Front	0.543***	0.130***	0.906***	1.231***
	(0.056)	(0.017)	(0.138)	(0.254)
Experience	-0.004***	-0.004***	0.018***	0.040***
	(0.001)	(0.000)	(0.005)	(0.009)
Constant	-0.419***	-0.024	1.074***	0.721***
	(0.061)	(0.017)	(0.213)	(0.231)
N	96043	76885	19158	9760
R^2	0.083	0.092	0.146	0.178

Note: * p < .1, ** p < .05, *** p < .01. Standard errors in parentheses are clustered at the level of the squadron ("Staffel"). The table repeats the analysis of Table 2, column 4, but stratifies by performance subgroup (results reported in columns 2-4).

Table 4: Risk of Death – Peer Performance Effects

	(1)	(2)	(3)	(4)
		Performance percentile:		
	Full sample	<80	80+	90+
Panel A: Estimates without controls				
Mention period	1.192***	1.195***	1.228**	1.035
	(3.42)	(2.96)	(2.33)	(0.29)
Past squadron peer of mentioned	2.102***	2.498***	1.343	1.120
	(4.06)	(4.07)	(0.92)	(0.37)
N	95890	76774	19116	9743
Panel B: Estimates with controls				
	(1)	(2)	(3)	(4)
	Full sample	<80	80+	90+
Mention period	1.111**	1.101*	1.181*	1.043
	(2.11)	(1.66)	(1.88)	(0.35)
Past squadron peer of mentioned	1.853***	2.194***	1.252	1.015
	(3.32)	(3.46)	(0.70)	(0.04)
Experience	0.998	1.002	0.994**	1.002
	(-1.42)	(1.13)	(-2.19)	(0.54)
Eastern Front	0.869**	0.671***	0.916	0.791**
	(-2.03)	(-4.66)	(-1.24)	(-2.36)
N	95890	76774	19116	9743

Note: * p < .1, ** p < .05, *** p < .01. Exponentiated coefficients. Standard errors in parentheses are clustered at the level of the squadron ("Staffel"). Estimates of hazard ratios from Cox regressions. T-statistics in parentheses. Panel B estimates also control for aircraft type (dummy variables for FW and BF models). Mentionperiod is a dummy variable that takes the value zero if no Luftwaffe fighter pilot is mentioned in the *Wehrmachtsbericht* during a month, and 1 otherwise. Past squadron peer is a dummy for pilots who, in the past (but not at the moment of the mention), served with the mentioned pilot in the same squadron ("Staffel"). All regressions include individual dummy variables (PastpeerX') indicating whether a pilot had flown with an eventually mentioned pilots in the past. Eastern front is a dummy for pilots serving on the Russian front. Experience is the number of months of wartime service since the start of World War II, beginning with the first victory claim in our records (except for veterans of the Spanish Civil War, for whom we add months of service there after the first victory claim).

Table 5: Correlation of Pilot Performance, Past Peers and Mentioned Pilot (Mention vs Other Periods)

	(1) Baseline	(2) Controls	(3) +TimeFE+SqFE	(4) Samegroup=0	(5) Placebo
$\text{Log}(\text{vic}_{\text{mi}} + 0.01)$	0.114***	0.090***	0.041***	-0.005	0.008
	(0.009)	(0.008)	(0.007)	(0.008)	(0.008)
Mention period	-0.128	-0.137	-0.178**	-0.154*	0.314
	(0.087)	(0.088)	(0.086)	(0.090)	(0.957)
Mention period * $\text{Log}(\text{vic}_{\text{mi}} + 0.01)$	0.062**	0.072**	0.071**	0.075**	-0.045
	(0.031)	(0.030)	(0.032)	(0.035)	(0.340)
Eastern Front		0.476***	0.600***	0.461**	0.310*
		(0.082)	(0.154)	(0.184)	(0.162)
Experience		-0.015***	-0.018***	-0.011***	-0.021***
		(0.003)	(0.003)	(0.003)	(0.004)
Constant	-3.129***	-3.023***	-2.135***	-3.055***	-1.514
	(0.043)	(0.105)	(0.678)	(0.765)	(1.395)
N	41737	41737	41737	22115	19339
R^2	0.023	0.049	0.152	0.183	0.178

Note: * p < .1, ** p < .05, *** p < .01. Standard errors in parentheses are clustered at the level of the squadron ("Staffel"). Dummy variables for aircraft type are included from col (2) onwards. $\text{Log}(\text{vic}_{\text{mi}}+0.01)$ is the natural logarithm of pilot m's victory score (+.01), when m is a former peer of pilot i. Mention period is a dummy variable that takes the value one when a former peer is mentioned in the *Wehrmachtbericht.* In col (4), we only keep those observations for which pilots and their eventually mentioned squadron peer are not in the same group. Col (5) uses the same specification as the preceding column but is based on placebo mentions (cf. Appendix for details). Eastern front is a dummy for pilots serving on the Russian front. Experience is the number of months of wartime service since the start of World War II, beginning with the first victory claim in our records (except for veterans of the Spanish Civil War, for whom we add months of service there after the first victory claim).

Table 6: Sample Splits

	(1)	(2)	(3)	(4)
Panel A				
	≥ mentioned	< mentioned	East	West
Past squadron peer of mentioned	1.123***	0.075	0.552***	0.089
	(0.334)	(0.104)	(0.209)	(0.085)
Past group peer of mentioned	0.585***	-0.020	0.294**	0.011
	(0.153)	(0.069)	(0.138)	(0.044)
Past base peer of mentioned	0.511***	-0.004	0.190**	-0.023
	(0.093)	(0.043)	(0.081)	(0.023)
Panel B				
	(1)	(2)	(3)	(4)
	Officers	Non-Officers	After Aug. 42	Before Aug. 42
Past squadron peer of mentioned	0.349**	0.301**	0.546**	0.020
	(0.175)	(0.138)	(0.215)	(0.134)
Past group peer of mentioned	0.107	0.125	0.098	0.091
	(0.104)	(0.080)	(0.108)	(0.077)
Past base peer of mentioned	0.060	0.156***	0.145**	0.085*
	(0.061)	(0.046)	(0.071)	(0.049)

Note: * p < .1, ** p < .05, *** p < .01. Standard errors in parentheses are clustered at the level of the squadron ("Staffel"). Each entry in this table shows the coefficient of interest from a regression as specified in Table 2, col. 4-6. Hence the first entry in column 1 here is the coefficient on past peer of mentioned, using the specification from Table 2, col. 4, etc. For variable definitions cf. Table 2.

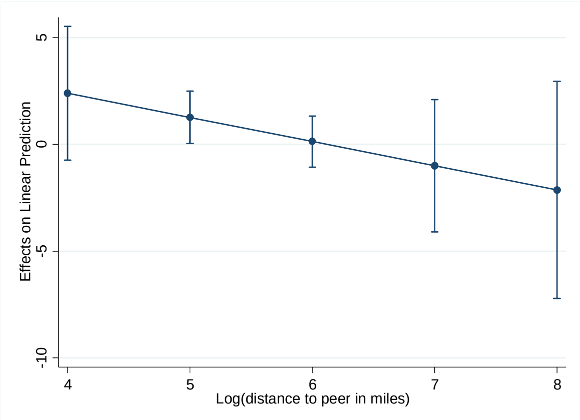
Table 7: Time Since Joint Service

	(1)	(2)
	≥ median time since exposure	< median time since exposure
Past squadron peer of mentioned	0.259**	0.393*
	(0.124)	(0.201)
Past group peer of mentioned	0.182*	0.062
	(0.093)	(0.091)
Past base peer of mentioned	0.046	0.171***
	(0.045)	(0.064)

Note: * p < .1, ** p < .05, *** p < .01. Standard errors in parentheses are clustered at the level of the squadron ("Staffel"). Each entry in this table shows the coefficient of interest from a regression as specified in Table 2, col. 4-6. Hence the first entry in column 1 here is the coefficient on past peer of mentioned, using the specification from Table 2, col. 4, etc. For variable definitions cf. Table 2.

APPENDIX

Figure A1: Marginal Effect of Being a Past Peer of a Mentioned Pilot As a Function of (log) Birthplace Distance (in Miles)



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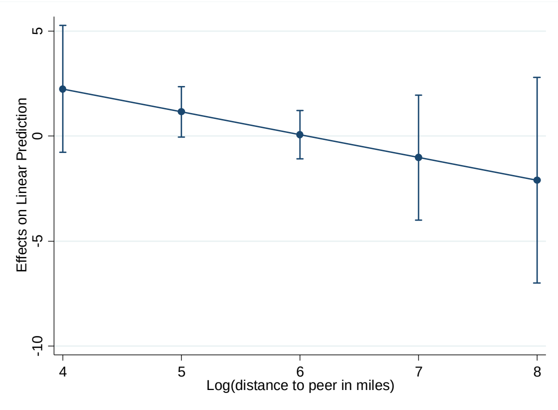
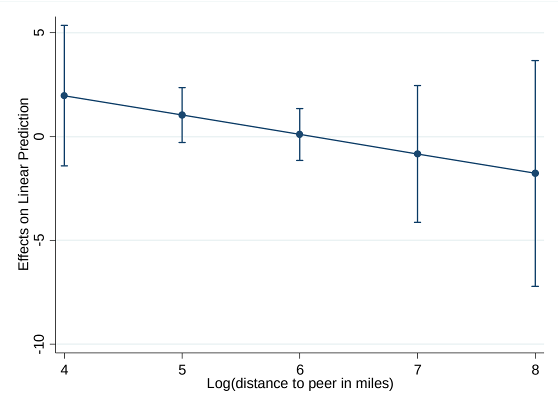
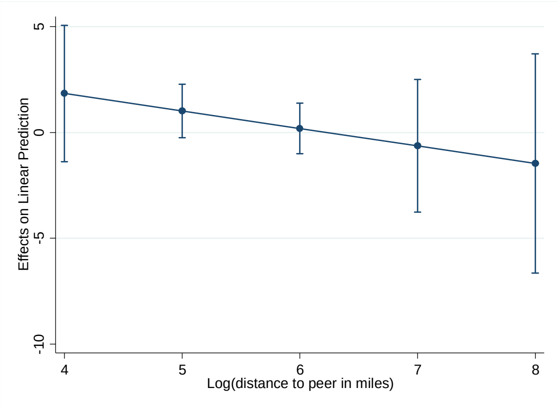


Controls for experience, front, and fighter model



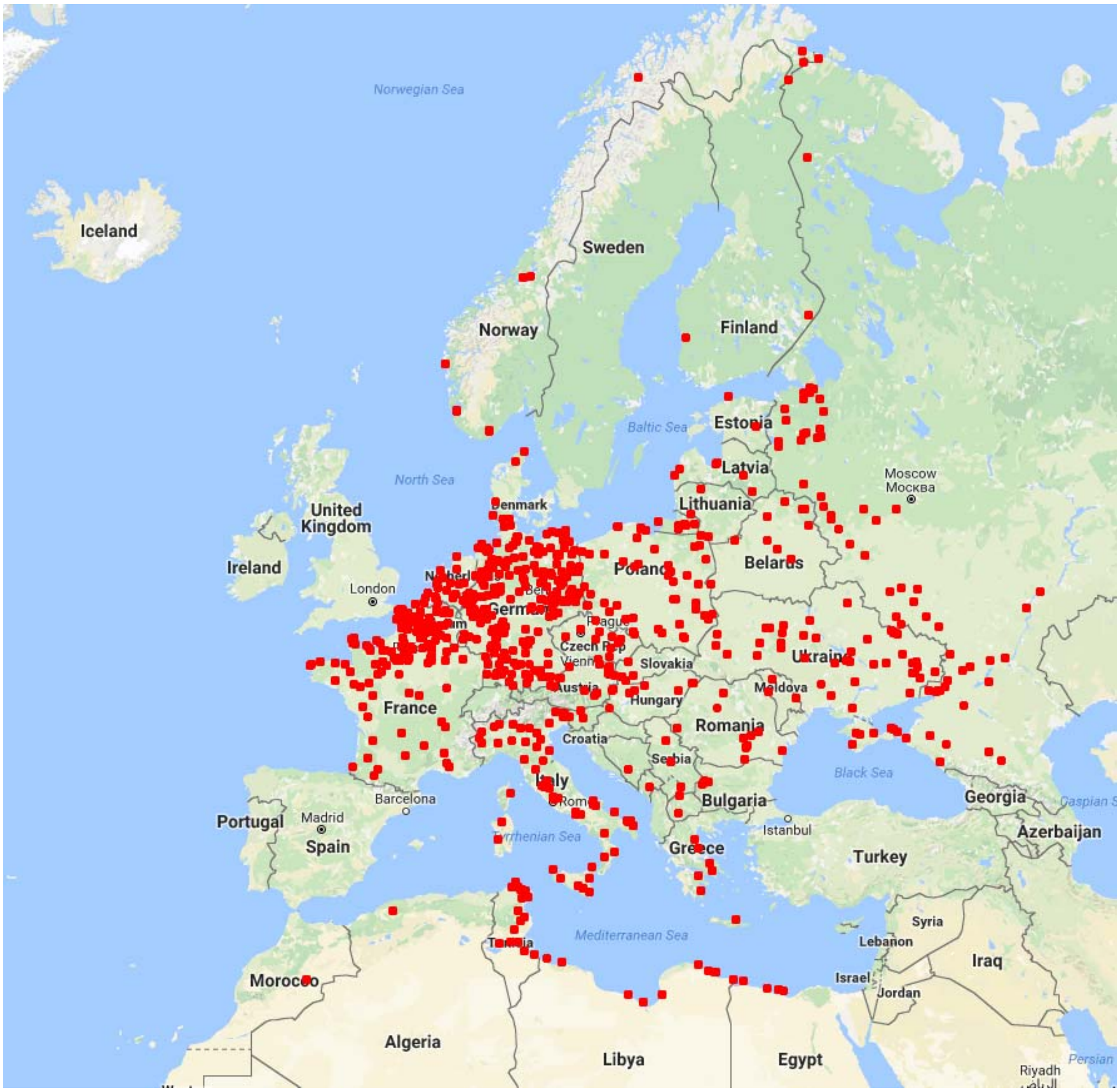
Adding Squadron FE



Adding Time FE

Note: Specifications analogous to Table 2, columns 1-4.

Figure A2: Airfield Locations of Luftwaffe Squadrons, 1939–1945



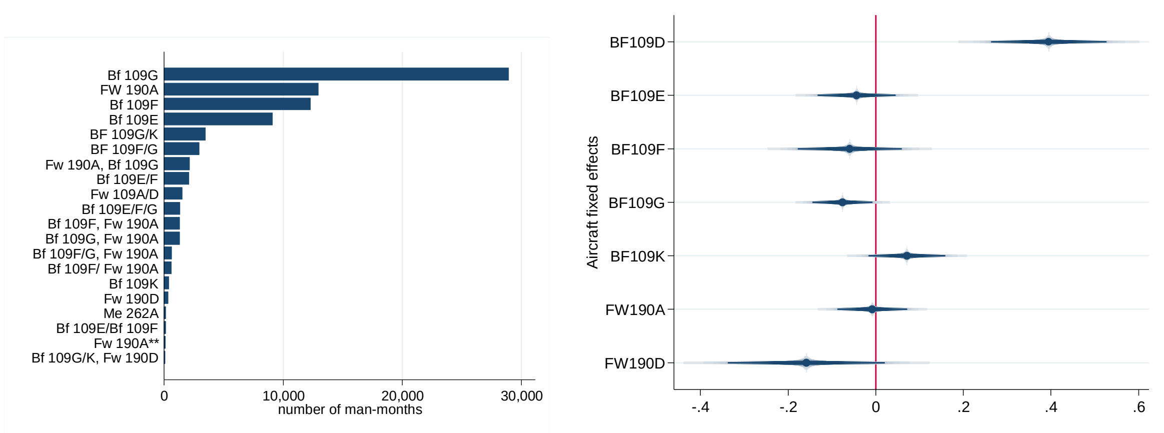
Note: This map plots the location of every airfield from which pilots in our dataset flew at least once during the period September 1939 to May 1945.

Table A1: Adding Pilot and Squadron Fixed Effects

	(1) PastpeerX	(2) PilotFE	(3) pastSqFE	(4) Sq*TimeFE
Past squadron peer of mentioned	0.340***	0.330***	0.311**	0.375**
	(0.123)	(0.119)	(0.127)	(0.181)
Past group peer of mentioned	0.122*	0.090	0.104	0.418***
	(0.068)	(0.066)	(0.066)	(0.107)
Past base peer of mentioned	0.110**	0.095**	0.110**	0.154***
	(0.045)	(0.041)	(0.043)	(0.058)
N	96043	96043	96043	96043

Note: * p < .1, ** p < .05, *** p < .01. Standard errors in parentheses are clustered at the level of the squadron ("Staffel"). Each column gives the result of three regressions, reporting only the coefficient on past peers. The first column of this table replicates the results of Table 2, col. 4-6. Column 2 repeats the same specifications but include pilot fixed effects instead of the PastpeerX' dummies. Column 3 includes individual dummies for each **past** squadron of pilots instead of normal squadron fixed effects, and column 4 includes the interaction of squadron and time fixed effects. For variable definitions cf. Table 2.

Figure A3: Aircraft Type – Usage and Fixed Effect (95% and 99% CIs) on Victory Scores



Note: The left panel of Figure A3 plots the number of man-months in our data set of different aircraft types (or combinations) flown by squadrons. The right panel plots the fixed effects for the main aircraft types in a regression using the specification of Table 2, col. 4.

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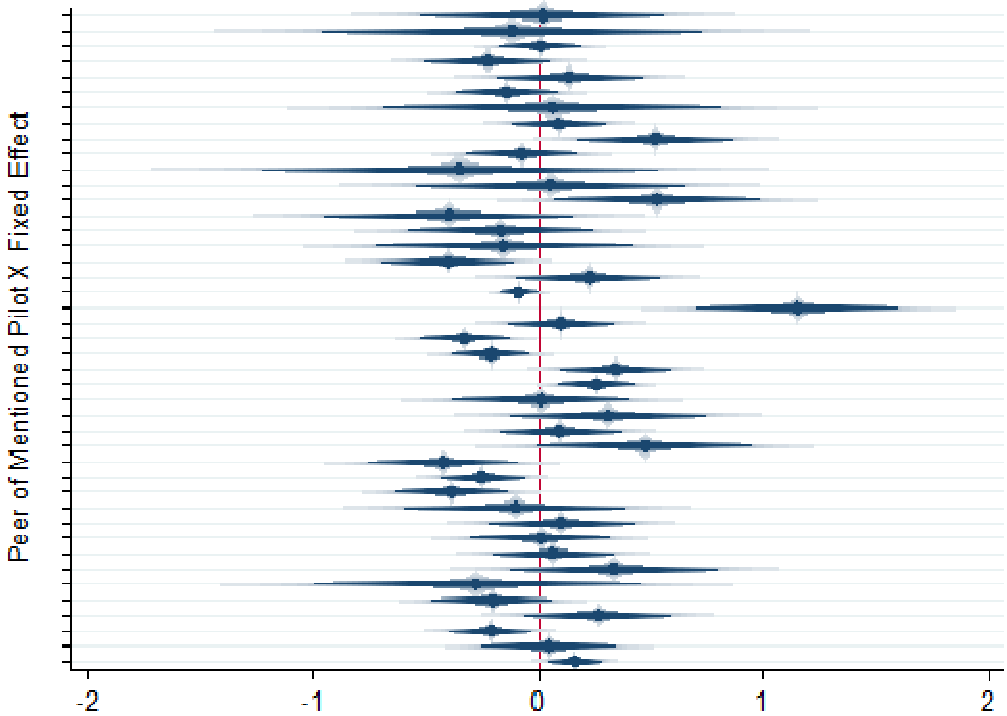
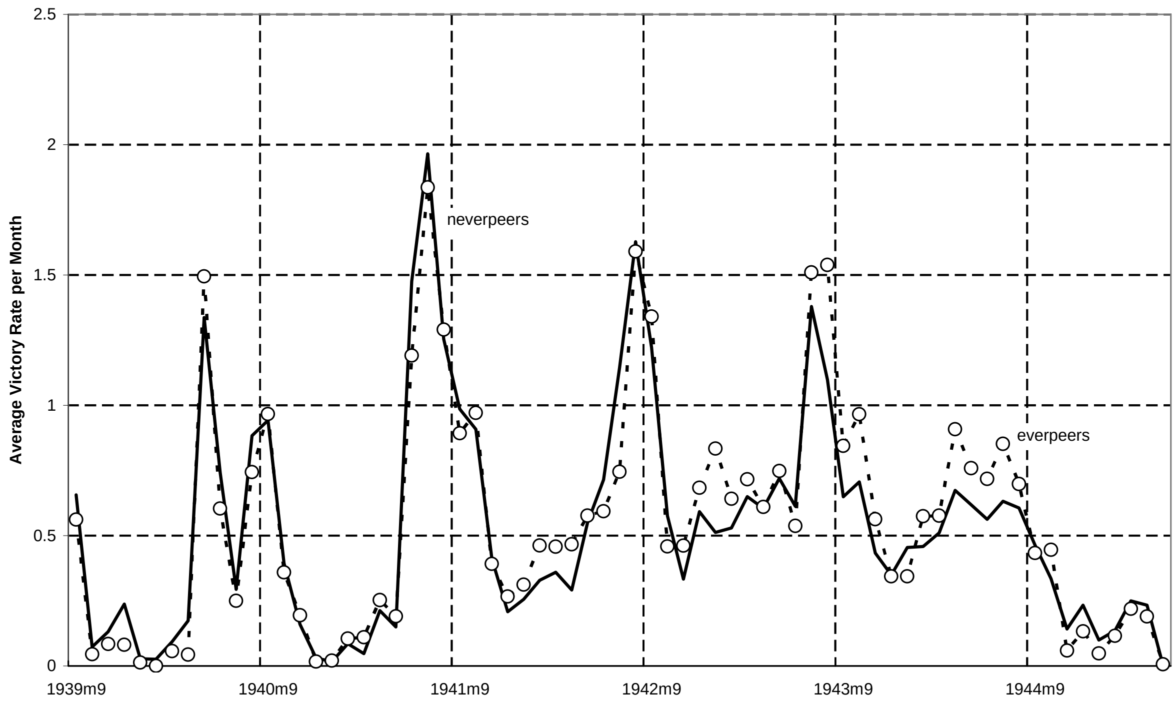
Figure A4: Fixed Effects of Pilots Who Are or Become Peers of Mentioned Pilots



Note: Each point represents the estimated fixed effects for pilots who become peers of a pilot who is eventually mentioned in the *Wehrmachtsbericht* (estimated for the sample as a whole).

Figure A5: Average Score over Time: Neverpeers versus Everpeers



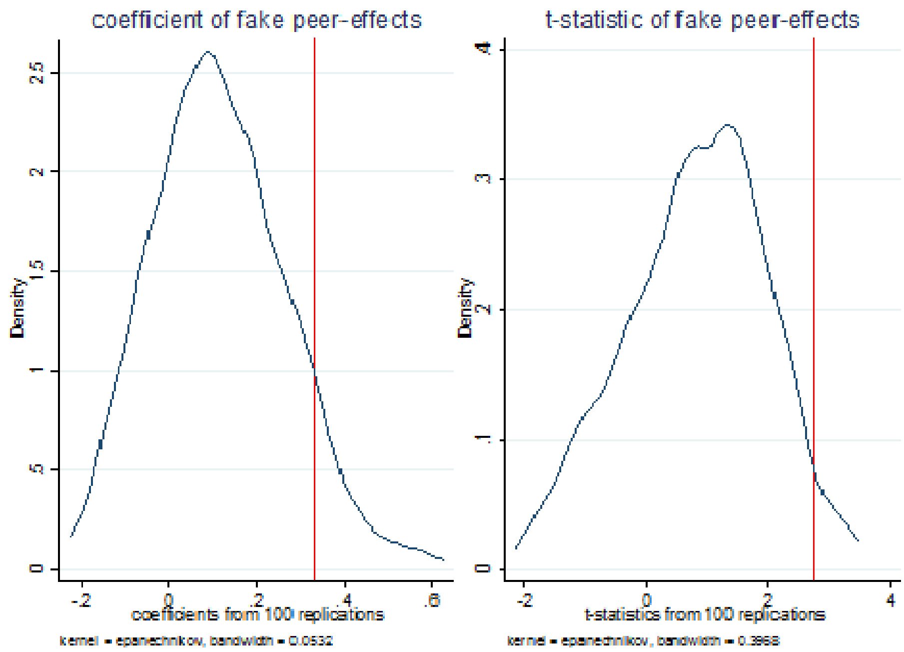
Note: The graph plots mean monthly victory scores for pilots who never flew with a mentioned pilot ("Neverpeers", solid curve) and for pilots who did fly with one at least once ("Everpeers", dashed curve).

Table A2: Placebo Mentions Conditional on Peer Performance (Correlations Data Set)

	(1) Baseline	(2) Controls	(3) +TimeFE+SqFE	(4) Samegroup=0
$\text{Log}(\text{vic}_{\text{mi}} + 0.01)$	0.129***	0.104***	0.042***	0.008
	(0.012)	(0.012)	(0.010)	(0.008)
Mention period	-0.575	-0.401	-0.404	0.314
	(0.803)	(0.756)	(0.603)	(0.957)
Mention period * $\text{Log}(\text{vic}_{\text{mi}} + 0.01)$	0.173	0.109	0.173	-0.045
	(0.292)	(0.276)	(0.219)	(0.340)
Eastern Front		0.553***	0.759***	0.310*
		(0.091)	(0.132)	(0.162)
Experience		-0.0298***	-0.0298***	-0.0206***
		(0.003)	(0.003)	(0.004)
Constant	-3.022***	-2.717***	-2.019*	-1.514
	(0.052)	(0.107)	(1.065)	(1.395)
N	42882	42882	42882	19339
R^2	0.027	0.080	0.166	0.178

Note: * p < .1, ** p < .05, *** p < .01. Standard errors in parentheses are clustered at the level of the squadron (“Staffel”). Columns 1-4 show all coefficients of interest from regressions as specified in Table 5, columns 1-4. All results are based on placebo mentions instead of real mentions.

Figure A6: Monte Carlo Simulations – Distribution of Coefficients and *t*-statistics



Note: The left panel shows the distribution of coefficients for the *Pastsquadronpeer* variable based on the specification in column (2) of Table A1. As described in the text, we randomly draw 0.01% of observations and designate them as placebo mentions; the distribution gives values after 100 simulations. The red horizontal line marks the estimated coefficient when instead actual mentions are used (and as reported in column (2) of Table A1). The right panel plots the corresponding *t*-statistics; here the red line marks the estimated *t*-statistic when the actual mentions are used.

Figure A7: Outperformance during Mention Periods, Former Peers, by Type of Mention