I Z A Institute
of Labor Economics
Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 17418

Stress in the Air: A Conjecture

Oded Stark

OCTOBER 2024

I Z A Institute
of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 17418

Stress in the Air: A Conjecture

Oded Stark
University of Bonn, University of Warsaw, and IZA

OCTOBER 2024

Any opinions expressed in this paper are those of the author(s) and not those of IZA. Research published in this series may include views on policy, but IZA takes no institutional policy positions. The IZA research network is committed to the IZA Guiding Principles of Research Integrity.

The IZA Institute of Labor Economics is an independent economic research institute that conducts research in labor economics and offers evidence-based policy advice on labor market issues. Supported by the Deutsche Post Foundation, IZA runs the world's largest network of economists, whose research aims to provide answers to the global labor market challenges of our time. Our key objective is to build bridges between academic research, policymakers and society.

IZA Discussion Papers often represent preliminary work and are circulated to encourage discussion. Citation of such a paper should account for its provisional character. A revised version may be available directly from the author.

ISSN: 2365-9793

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Stress in the Air: A Conjecture*

The 1949 study The American Soldier: Combat and Its Aftermath, Volume II, by Stouffer et al. presents detailed accounts of the attitudes of American fighter pilots toward the stress experienced by them and of the policies and practices of the American Air Force command in addressing this stress during WWII. The 2022 study "Killer incentives" by Ager et al. documents an aspect and a repercussion of the stress of German fighter pilots and can be used to identify the response to that stress by the German Air Force command during WWII. Drawing on these two studies, in this paper I construct fighter pilot stress profiles in the two air forces. The picture that emerges is that there is a stark difference between the approaches of the two commands. This diversity leads me to conjecture that the American Air Force command explicitly sought to forestall and curtail fighter pilots' stress, whereas the German Air Force command implicitly cultivated and engineered fighter pilots' stress.

JEL Classification: D01, D23, D9, E7, H56, I12, I38, J28, J38, J48, J58, N42, N44

Keywords: WWII, fighter pilots, combat missions, fighter pilot stress, policies and practices of the American Air Force in curtailing stress, policies and practices of the German Air Force in cultivating stress

Corresponding author:
Oded Stark
ZEF
Genscherallee 3
53113 Bonn
Germany
E-mail: ostark@uni-bonn.de

* I am indebted to reviewers for sound advice and thoughtful commentary, and to Joerg Baten for guidance.

1. Introduction

Two studies, published 73 years apart, shed fascinating light on the ways in which the American Air Force command and the German Air Force command dealt with fighter pilot stress during World War II. The two studies are *The American Soldier*: *Combat and Its Aftermath*, Volume II, by Stouffer et al. (1949), and "Killer incentives" by Ager et al. (2022).

In Chapter 7, "Morale attitudes of combat flying personnel in the air corps," and Chapter 8, "Objective factors related to morale attitudes in the aerial combat situation," in *The American Soldier*, Stouffer et al. present detailed accounts of the attitudes of fighter pilots toward the stress they experienced and of the policies and practices of the American Air Force command in addressing this stress. The entire "Killer incentives" study of Ager et al. is taken up by documentation of an aspect or a repercussion of the stress of fighter pilots and can be drawn upon to identify the response to that stress by the German Air Force command.

It goes without saying that a fundamental mission of an air force command is to devise practices and policies that facilitate the discernment of fighter pilots and support and induce their engagement in combat missions which, needless to add, are risk-laden. Drawing on the studies of Stouffer et al. and Ager et al., in the next two sections I construct profiles in this regard in the two air forces. The picture that emerges is that there is a stark difference between the approaches of the two commands. This diversity leads me to conjecture that the American Air Force command explicitly sought to forestall and curtail fighter pilots' stress, whereas the German Air Force command implicitly cultivated and engineered fighter pilots' stress.

2. American fighter pilots during WWII: A Stouffer-based impression

In the American Air Force, it was recognized by Air Force Headquarters (the American Air Force command) that combat flying was stressful ("extremely harassing," Stouffer et al., p. 324), that there were "cumulative psychological effects of successive exposures to the stress of aerial combat" (Stouffer et al., pp. 324-325), and that there was a "marked decline in motivation for combat flying which occurred with increased number of combat missions flown" (Stouffer et al., p. 352). Data analyzed by Stouffer et al. reveal that "there is a strong tendency for combat motivation to decline with successive exposures to combat" (Stouffer et al., p. 333), that "with increased number of missions flown, willingness for combat flying tended to deteriorate," and that symptoms of stress tended to increase (Stouffer et al., pp. 362-

363). Summarizing a large body of evidence, Stouffer et al. conclude that "with increased number of combat missions flown there was a decrease in willingness for combat flying and an increase in symptoms of chronic tension and anxiety" (Stouffer et al., p. 410).

The attitude or the perception of the fighter pilots was that "[i]f a limited, definite amount of combat duty is regarded as the requirement for satisfying the demands of one's society, and if this conception is sanctioned by one's peers and fostered by one's leaders, [then] the completion of this share tends to become a part of the individual's frame of reference for evaluating himself as a worth-while person" (Stouffer et al., p. 387). Stouffer et al. intimate that "there is a curve of diminishing returns in prestige - beyond a certain point, additional combat missions may bring only slight increments in deference; after a man has flown 15 or 20 missions, there is no longer a need for a man to prove himself; he knows that most of his comrades and the wider public will concede that he has shown himself capable of facing the test of hazardous combat and that he has contributed a larger share to the war effort than most other men" (Stouffer et al., p. 386). The policies of the American Air Force command left fighter pilots little room for guessing: "[A]lmost every combat air crew member had the strong expectation that, once he had completed his tour of duty, he would gain the much desired reward of being returned to the United States as a veteran who had done his share in combat, or, at least, the reward of being transferred to the relative safety of ground duty overseas" (Stouffer et al., p. 384). "[C]ombat flying personnel could look forward to relief from combat duty and return to the United States if they survived the hazards of a specific number of combat missions" (Stouffer et al., p. 359).

In tandem, the practice of the American Air Force command was to set a "definite termination point, as a consequence of the Air Corps practice of relieving combat air crew members from their combat assignment after they had completed a specified number of combat missions" (Stouffer et al., p. 325). The limit to the tour of duty of fighter pilots was 300 hours of combat flying, which was typically achieved in six or seven months of active combat duty. The policy response to fighter pilots' symptoms of stress was to rotate the fighter pilots from the European theater back to the United States, once they had completed the required number of combat missions. Moreover, "All fighter pilots were systematically examined throughout the entire period that they were on operational duty; as soon as any . . . anxiety reaction to combat flying was detected, the man was immediately removed from combat duty as a fighter pilot" (Stouffer et al., p. 408). Shielding the fighter pilots from stress

was to be achieved by relieving them from flying combat missions. Fighter pilots who were found to experience substantial stress were never made to engage in risk-laden combat missions, let alone in riskier ones. Stress was not considered a condition (a mental state) that could possibly be drawn upon (exploited) to induce intensified engagement in combat missions. Exposing fighter pilots to "a more strenuous work load" (Stouffer et al., p. 363), even allowing them to engage in a more strenuous workload, was extraneous to the core stance of the American Air Force command. Instituting predictable deployment, monitoring for undue distress, and minimizing strenuous workloads, enabled the American Air Force command to closely control the circumstances under which the fighter pilots operated. The stringent standardized working conditions reduced variation in the fighter pilots' performance.

3. German fighter pilots during WWII: An Ager et al. impression

The data assembled and analyzed by Ager et al. reveal that in the German Air Force (the Luftwaffe), stress experienced by fighter pilots was allowed and, as I argue next, was exploited to induce them to undertake both more combat missions (in the terminology of the preceding section, increase their workload) and riskier combat missions. Ager et al. provide evidence of increased risk taking in response to the stress experienced from a loss of rank. Analyzing data on fighter pilots whose peers were praised - received public recognition via citations in the armed forces bulletin - for outstanding accomplishments, Ager et al. remark that such citations were considered a great honor. Ager et al. assemble impressive evidence that for fighter pilots whose peers were praised, "risk taking [in combat missions] increased substantially after a peer's mention" (Ager et al., p. 2284). Specifically, Ager et al. find that these fighter pilots took greater risk in combat missions ("going after "marginal" and more dangerous and difficult victories," Ager et al., p. 2260) as a means of restoring their standing.

4. Discussion

What is particularly noteworthy is that the American Air Force command left no room for allowing possible rivalry between fighter pilots to translate into intensification of workload. The earlier citation of setting a "definite termination point" (Stouffer et al., p. 325) is not the only support of this perception. From Chapter 7 of Stouffer et al. I learn that awards and decorations for combat air crew members were given on the basis of completion of standard missions, so there was no reason for envy or loss of relative standing on account of comparison with fellow combat pilots. Most telling is the policy of the Air Force

Headquarters in the War Department, formulated early in the war, "that all operational units [that] engage in combat establish a tour of combat duty . . . with the aim of giving men on combat flying duty . . . a reasonable chance of survival" (Stouffer et al., p. 359). Because there was no differential treatment of fighter pilots resulting in loss of relative standing, there was no incentive for fighter pilots to ameliorate what was not sensed. As a result, there was no sense of the American Air Force command drawing on what did not exist.

While Ager et al. show that stress that arose from loss of rank when fellow fighter pilots gained prestige from citations in the armed forces bulletin for outstanding accomplishments induced fighter pilots to increase their willingness to undertake more and riskier combat missions, Ager et al. did not say that the German Air Force command encouraged or promoted public display and dissemination of praise of accomplished fighter pilots. However, that the German Air Force command had, quite obviously, the means and powers to suppress such information yet did not suggests that it sought to exploit display of that information as a tool for extracting intensified engagement of fighter pilots in combat missions. A good way of garnering support for this perception is by noting that, as already mentioned, the way in which public recognition of combat accomplishments was made available was an entry in the German armed forces daily *Wehrmachtbericht*. This bulletin was fully under the control of the public relations / propaganda department of the armed forces, so it was not possible for anything to appear there unless the Luftwaffe considered it desirable.

The "technology" that the German Air Force command employed to instill stress was based on the creation of rivalry as an intervening variable. The policies and practices that I referred to amounted to the formation of fellow fighter pilots as a substantial reference group that, upon unfavorable comparisons with the group, inflicted relative deprivation.

In addition to side-stepping the need to report on the explicit policy of the German Air Force command, Ager et al. do not present a behavioral model according to which rank deprivation transforms into greater willingness to undertake risk-laden combat missions. For this omission, a correction can be made. By means of a constructive example, in a short appendix, I show formally how loss of rank triggers greater willingness to take risks.

All in all, the picture that emerges is that with regard to the treatment of the stress of fighter pilots, the approaches of the American and German Air Forces differed. My conjecture is that in the American Air Force, the policy was to neutralize stress, not to encourage its

formation by differential treatment of combat pilots, and not to use any manifestation of fighter pilots stress as a tool for extracting intensified engagement in combat. Stress was considered an impairment to success in carrying out dangerous combat missions. In the German Air Force, the policy amounted to taking advantage of stress. With the purpose in mind of encouraging the undertaking of dangerous combat missions, stress arising from the gain in prestige of fellow fighter pilots served as a policy tool.

It might be argued that the characterization of the practices and policies of the German Air Force command is applicable to the late war period when pilot loss rates were running high, many squadrons found themselves down to a handful of pilots, and new pilots were less well trained and suffering high attrition rates.[1] It is under these conditions that "engineering" social-psychological stress can be regarded as constituting a particularly appealing incentivizing tool. However, from the data in the Ager et al. study I can gather that the practice of forestalling fighter pilots' stress was employed throughout the war years, including in the opening phase of the war in which the German Air Force enjoyed air supremacy.

The difference between the ways in which the two Air Force commands related to fighter pilots' stress seems to be in line with the general way in which the two armies viewed combat fatigue. As noted many times in the Stouffer et al. study, the American army was well aware of and sympathetic to the problem of psychiatric combat breakdown (by 1943 providing treatment for psychiatric casualties, either at forward stations near the front or in dedicated hospitals closer to the rear), whereas the German army was generally hostile to the idea of psychiatric breakdown and those who were considered guilty of malingering or cowardice were not treated well (consult also Overy, 2021).

It goes without saying that it is the practice of armies of all types to acknowledge good service, acts of bravery, and extraordinary achievements. In that regard, the American Air Force was no exception; it too awarded medals. Because the American Air Force command rotated fighter pilots out of active service and regulated their time of duty, and because medals were conferred subsequently, the impact of these awards was limited and did not create rivalry and stress as was the case with the German Air Force command.

---

[1] Evans (2009) reports that by May 1944, the German Air Force was losing 25% of its fighter pilots every month.

It is tempting to search for a reason for the different stances of the commands of the two air forces. A possible explanation could be the difference between the perceptions of the types of war that Germany and America preferred to engage in. This difference could, in turn, be attributed to the fact that the source bases in support of the war efforts were at variance. Germany built on quick and early successes and drew on exploitation of conquered territories and humans (procurement from occupied Europe) to keep its war machinery afloat. America with its tremendous wealth and industrial structure was economically strong and endowed with sufficient resources (procurement from within its economy) to withstand a long war. In this respect, winning the war early on was more important for Germany than for America.[2] The vast economic advantage that America held over Germany would make victory by America and its allies more likely in a long-lasting war.[3] No wonder, then, that Germany would be more willing to sacrifice members of its elite pilot units for the chance of avoiding a protracted war.

5. Concluding remarks

Kahneman (2011) studied closely the topic of how to motivate air force pilots to improve their performance. Kahneman cites a concern raised by flight instructors in the Israeli Air Force that praising pilots for good performance was not effective because after receiving such praise, pilots tended to do worse. Kahneman's explanation for that had to do with the concept of "regression to the mean," which describes how performance tends to return to its average over time: if a pilot has an exceptionally good performance on a certain occasion - far better than his personal average - then he will probably do worse next time (closer to his average) simply by random chance. So praising a pilot had no effect (and, likewise, criticizing pilots for bad performance and observing them doing better in their next performance). Kahneman suggested that praising a pilot was not a causal factor in affecting performance. It is obviously not reasonable to suggest that the German Air Force command was thinking along these lines: however, what is revealing is that, as already explained, to improve performance in the sense

[2] Harrison (1998) notes that the Western Allies were better prepared for a prolonged war, as they could tap into more expansive resources ("superior GDP and population numbers") than the Axis powers.

[3] It is safe to assume that German lessons of WWI included recognition that Germany could not afford to wage a protracted war. In WWI, Germany was overwhelmed by the Allies' material and economic superiority, presumably leading it to reason that fast mobile offensives would be necessary to avoid the kind of prolonged struggle it could not win. Conceivably, this philosophy had a bearing on the Luftwaffe's "culture" of deployment.

of incentivizing pilots to undertake more taxing / daring combat missions, the praise was of *fellow* air force pilots.

It is up to military historians and psychologists to analyze the extent to which the two types of policy contributed to the successes and failures of fighter pilots of the two air forces in the European theater during WWII, and it is up to expert analysts to determine which policies and practices should be followed and implemented in wars nowadays, and in wars to come. Still, could it be that the explicit American approach, as opposed to the implicit German approach as characterized in this paper, contributed to the American Air Force gaining the upper hand during WWII?

Appendix. **Modeling the manner in which rank preferences modulate risk-taking preferences**: **A constructive example**

Consider an air force, henceforth a "population of fighter pilots," of measure 1 in which I index fighter pilots by a continuous number, $\rho \in [0,1]$. I equate the index number of a fighter pilot with the fraction of those in the population of fighter pilots whose ranks are lower than his. The fraction of lower-ranked fighter pilots is ρ, and the fraction of higher-ranked fighter pilots is $1-\rho$. The term $1-\rho$ measures the fighter pilot's rank deprivation.

Let the fighter pilot's concern for rank be expressed as

$$U(\rho) \equiv -[1+(1-\rho)]^{\beta} = -(2-\rho)^{\beta}, \tag{1}$$

where $\beta > 1$. This is not to deny the plausible prevalence of other reasons / factors of concern, but for the sake of concentrating on essentials I omit them here.

The fighter pilot who occupies the top rank experiences no rank deprivation. For this pilot $1-\rho = 0$, so his $U(\rho)$ function is at a maximum of -1. For a fighter pilot who occupies the bottom rank $1-\rho = 1$, so his $U(\rho)$ function is at the maximum of -2^{β}.

To assess how a fighter pilot's willingness to take risks responds to a change in his rank, I draw on a measure of risk aversion. To this end, I employ the Arrow-Pratt index of relative risk aversion (Pratt, 1964; Arrow, 1965, 1970). In the case of (1), the index of relative risk aversion with respect to rank is

$$r(\rho) \equiv \frac{-\rho U''(\rho)}{U'(\rho)}.$$

As will become evident, employing the Arrow-Pratt index of absolute risk aversion, $R(\rho) \equiv \frac{-U''(\rho)}{U'(\rho)}$, will yield the same insight as that yielded when employing the Arrow-Pratt index of relative risk aversion.

From (1) the derivatives are

$$U'(\rho) = \beta(2-\rho)^{\beta-1}$$

and

$$U''(\rho) = -\beta(\beta-1)(2-\rho)^{\beta-2}.$$

The index of relative risk aversion as a function of ρ is

$$r(\rho) = (\beta - 1)\frac{\rho}{2 - \rho}.$$

Therefore,

$$r'(\rho) = (\beta - 1)\frac{2}{(2 - \rho)^2} > 0.$$

Thus, when the fraction of lower-ranked fighter pilots, ρ, is lower, which is tantamount to the reference fighter pilot occupying a lower rank and thereby experiencing higher rank deprivation, the reluctance of the reference fighter pilot to accept risky combat missions is lower. Put somewhat differently, when the reference fighter pilot loses rank, he becomes more willing to take risk-laden combat missions.

References

Ager, Philipp, Bursztyn, Leonardo, Leucht, Lukas, and Voth, Hans-Joachim (2022). "Killer incentives: Rivalry, performance and risk-taking among German fighter pilots, 1939-45." *The Review of Economic Studies* 89: 2257-2292.

Arrow, Kenneth J. (1965). *Aspects of the Theory of Risk Bearing*. Helsinki: Yrjö Jahnssonin Säätiö.

Arrow, Kenneth J. (1970). *Essays in the Theory of Risk-Bearing*. Amsterdam: North-Holland.

Evans, Richard J. (2009). *The Third Reich at War 1939-1945*. New York, NY: Penguin.

Harrison, Mark (1998). "The economics of World War II: an Overview." In: Harrison, Mark (Ed.) *The Economics of World War II*: *Six Great Powers in International Comparison*. Cambridge: Cambridge University Press, pp. 1-42.

Kahneman, Daniel (2011). *Thinking, Fast and Slow*. New York, NY: Farrar, Straus and Giroux.

Overy, Richard (2021). *Blood and Ruins*: *The Last Imperial War, 1931-1945*. New York, NY: Penguin.

Pratt, John W. (1964). "Risk aversion in the small and in the large." *Econometrica* 32 (1-2): 122-136.

Stouffer, Samuel A., Lumsdaine, Arthur A., Lumsdaine, Marion Harper, Williams Jr., Robin M., Smith, M. Brewster, Janis, Irving L., Star, Shirley A., and Cottrell Jr., Leonard S. (1949). *The American Soldier*: *Combat and Its Aftermath*, Vol. II. *Studies in Social Psychology in World War II*. Princeton, New Jersey: Princeton University Press.