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INTERACTIVE EFFECTS OF COGNITIVE REPRESENTATIONS OF FORMIDABILITY AND TECHNOLOGY

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14. ABSTRACT

This project demonstrated that, in individual decision making, a single cognitive representation captures the three components of threat assessment: fighting capacity of the foe relative to self, likelihood that the foe will attack, and assets at risk if the foe attacks. The visualized physical size and strength of an individual foe, or of a representative of an enemy coalition, summarizes these assessments and their constituents. This was explored by manipulating (a) the fighting capacity of the assessor; (b) the fighting capacity of the foe; and (c) the likelihood that the foe would attack; and by examining (d) natural variation in assets at risk. In the final year, research was published on the contributions to representations of a potential foe of i) own physical strength (per [a]); ii) participation in synchronized behavior (per [a]); iii) knowledge of another's propensity to take risks (per [c]); iv) status as a parent (per [d]); and v) hormonal status (per [d]). Papers under review or in preparation address vi) cultural stereotypes regarding the propensity toward violence (per [c]); vii) signals of commitment to a hostile coalition (per [c]); viii) the role of personality (per [c]); and ix) the effects of religious cognition (per [a]). In sum, employing simple, field-deployable methods suitable for use with pre-literate populations, it is possible to assess diverse components of judgments of the threat posed by potential adversaries.

15. SUBJECT TERMS

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Project Overview

In situations of potential violent conflict, individuals must rapidly decide whether to fight, flee, appease, or negotiate. This is true both in one-on-one conflicts and when coalitions are involved. This project documented that, to facilitate rapid decision-making in such situations, the mind uses a simple cognitive representation that compiles assessments of diverse factors into a single accessible summary.

The process of assessing the threat posed by another party can be logically decomposed into three distinct objectives. First, the actor must assess the fighting capacity of the other relative to that of the self. However, relative fighting capacity is not the sole determinant of the threat posed, as, for example, a formidable party who is allied with the actor not only poses no threat, but, moreover, reduces the threat that third parties might pose. Furthermore, as suicide bombings and other tactics of asymmetric warfare reveal, even highly favorable disparities in relative fighting capacity may not eliminate the threat that another party poses – determined opponents can inflict significant damage despite possessing vastly inferior fighting capacity. Accordingly, in addition to relative fighting capacity, threat assessment must include an evaluation of the likelihood that the other party will attack. Lastly, the potential cost of any given attack is a function not only of relative fighting capacity, but also of the extent to which the actor stands to lose important assets if an attack occurs – even when in possession of vastly

superior fighting capacity, an actor having significant assets at risk faces a greater threat than an actor with few such assets in harm's way. In deciding how to address a situation of potential conflict, the actor must thus consider three logically distinct classes of information – what are the parties' fighting capacities relative to one another, how likely is the other party to attack, and what assets are at risk in the event of an attack. Rapid decision making requires that the products of each of these three facets of threat assessment be combined, such that a single unified assessment provides clear direction with regard to the behavioral options available – engaging in on-the-one-hand-but-on-the-other-hand deliberations due to an inability to compile two or more different kinds of threat assessment introduces delays that can be fatal.

The same problem of needing to compile multiple factors into a single assessment also occurs within each of the three facets of threat assessment. For example, relative fighting capacity will be a function of many divergent features of the parties, such as their respective physical conditions; their access to weaponry and defensive technologies; their fighting skill; the number and proximity of their allies; the quality of their leadership; their degree of unit cohesion; and so on. All of these factors must be combined into a single assessment if decision-making is to be rapid and effective. This project investigated the thesis that the same solution is applied at both high and low levels of abstraction in this assessment process. In animals possessing only a simple behavioral repertoire, bodily size and physical strength are the primary determinants of relative fighting capacity. It is therefore to be expected that all vertebrates possess the capacity to cognitively represent physical size and strength. In humans, this elementary capacity serves as the foundation for complex assessments of the type described above. This project operationalized the hypothesis that decision-makers construct a 'mind's-eye image' in which the physical body of the opponent is visualized, with the dimensions of physical

size and physical strength serving to summarize diverse facets of threat assessment. In essence, each time a relevant variable is evaluated, the mind's-eye image is adjusted in light of said factor – if the evaluation reveals elevated threat (e.g., the opponent is armed; the evaluating actor is incapacitated; etc.), then the mind's-eye image grows; if the evaluation indicates diminished threat (e.g., the opponent's coalition has lost its leader; the actor's allies are nearby; etc.), then the mind's-eye image shrinks. Thus, this project demonstrated that this simple, vivid representation serves as a common currency for diverse assessment processes, operating as a running tally that is adjusted as each in a series of factors is evaluated. Moreover, this holds both at the most prosaic levels (e.g., gun beats knife, etc.), and at the highest levels of abstraction (e.g., combining an assessment of likelihood of attack with an assessment of assets at risk).

In parallel with the objective of documenting the use of a common summary representation across diverse facets of threat assessment, this project leveraged this thesis to investigate a large number of discrete predictions pertaining to specific features of the actor or the foe. Thus, the project created a body of research that simultaneously provides compelling evidence regarding the overarching threat assessment process and examines how physical, technological, social, and physiological considerations each contribute to responses to potential conflict. Below, highlights of the various sub-projects are briefly described. For purposes of clarity, these are presented in logical, rather than chronological order; publication numbers refer to the publications list provided at the end of this document.

Summary of Specific Findings

Relative Fighting Capacity

Turning first to relative fighting capacity, weapons are a key determinant of this feature, hence exploration of this factor constituted initial proof-of-concept for the larger project. Consonant with the core hypothesis, knowing that a target individual is armed leads observers to conceptualize him as larger and stronger (Publication 1). Similarly, as can be expected from their elementary role in combat, bodily aspects of the observer influence the observer's conceptualization of the size and strength of a prospective antagonist. Publication 9 documents that a man's own muscular strength is inversely related to the physical formidability that he envisions an opponent to have, such that stronger men conceptualize their foes as smaller and weaker in absolute terms than do weaker men, a disparity that is objectively erroneous but representationally effective. Publication 6 demonstrates the inverse effect, namely that temporary physical incapacitation leads men to envision their opponents as larger and stronger, and themselves as smaller and weaker.

Coalitional behavior is a key determinant of relative fighting capacity. Publication 5 documents that the presence of allies leads men to reduce their estimations of the bodily formidability of a foe. This paper (published in *Psychological Science* and cited 22 times in the past year) reveals the extent to which threat assessment is sensitive to what would otherwise seem mundane circumstances – the mere physical proximity of friends in an everyday context reduces participants' judgments of the threat posed by a convicted terrorist. Effective leadership influences the lethality of a fighting force and, correspondingly, knowing that a violent coalition does or does not possess capable leaders causes parallel changes in participants' estimations of the bodily formidability of a typical coalition member (Publication 4). These results provide

quantitative evidence that targeting enemy leadership can effectively serve the dual function of disrupting command-and-control and exercising substantial indirect influence, including shaping the perceptions of third-party observers who have yet to commit to one side or another in a conflict.

Also related to the question of coalitional behavior, synchronized marching and similar drills are ubiquitous in all modern militaries, and are increasingly imitated by armed non-state entities as well. A considerable literature documents the positive effects of synchronized behavior on cooperation and coalitional solidarity. Internal cohesion and the ability to effectively coordinate actions across members of a fighting force are key determinants of fighting capacity. Publication 12, published recently in *Biology Letters* to widespread media acclaim, demonstrates that people are so attuned to the experience of synchrony that, absent any martial framing whatsoever, synchronized walking by itself decreases men's estimations of the bodily formidability of an antagonist. Once again, this reveals the ease with which the threat-assessment mechanism can be activated, and the nearly ever-present sensitivity to variables relevant to this process.

Religion plays a critical role in many contemporary armed conflicts. Although existing research successfully explores the centrality of religion in conflict via its contribution to identity formation and the motivating power of sacred values, these accounts overlook a central feature of all world religions, namely that they depict deities as social actors. A substantial literature in the cognitive science of religion documents how religious cognition relies on mechanisms that normally operate in the social domain. Extending such work into the realm of threat assessment, Publication 17 documents that religious cognition influences perceptions of an opponent in a similar manner to the presence of allies or the experience of synchronized behavior, as priming

thoughts of God leads people to conceptualize a foe as less physically imposing, and themselves as better protected by others.

Likelihood of Attack

Turning next to the second component of threat assessment, likelihood of attack, this project examined how both individual-level and group-level factors contribute to such calculations. At the level of forecasts based on cues of individual propensities, Publications 7 and 13 document that target individuals who are prone to engage in non-violent physical risk-taking are conceptualized as more physically formidable than those who are risk-averse, a pattern consonant with the inference that individuals who are relatively indifferent to the possibility of injury or death are more likely to enter into combat and less likely to retreat. Demonstrating the broad utility of this research framework, these results illuminate the causes driving epidemiological correlations between participation in non-violent physical risk-taking and participation in violence, as well as the exacerbating effects of the presence of an audience on both forms of behavior. Specifically, because it conveys information about likelihood of attack, non-violent risk-taking serves as an effective signal for violence-prone individuals who wish to deter adversaries and attract allies. A similar signaling dynamic also obtains in the case of overt markers of coalitional allegiance. In situations entailing possible conflict with members of rival coalitions, individuals who display such markers (e.g., dress, adornment, tattoos, and similar indices of group affiliation) simultaneously invite conflict and commit themselves to it should it erupt, as those displaying group affiliation cannot feign neutrality. Publication 14 documents that, in conflict situations, overt displays of markers of group affiliation are rapidly processed as indicating increased likelihood of attack, and thus increased envisioned size and strength.

Often, threat assessment must be conducted without the opportunity to observe specific features of individual behavior. Under such circumstances, information pertaining to the group or category to which a target individual belongs will often be employed in an effort to determine likelihood of attack. While this can be functional when said information is veracious, it also opens the door to the deployment of inaccurate and prejudicial stereotypes. Publication 15 documents the role of racial stereotypes in this regard, revealing that the flexibility of such assessments is particular to the group at issue, as some racial stereotypes are readily displaced by countervailing individual-level information germane to likelihood of attack, but others are not so easily overwritten.

While features of others play a central role in assessments of the likelihood of attack, features of the assessor's own personality also importantly contribute to this process. Although debilitating when it occurs in an extreme and psychopathological manifestation, paranoia also commonly occurs at subclinical levels, being one axis of personality variation. Contrary to folk models of paranoia as characterized exclusively by insecurity, a central thread in paranoid ideation is grandiosity, the exaggerated sense of one's own importance – paranoid individuals fear that others are conspiring against them not by chance, but because they themselves are so significant that others are plotting to overthrow or contain them. This combination produces a seemingly paradoxical influence on threat assessment. As documented in Publication 17, in a sample of normal individuals in the general population, measures of paranoia correlate *negatively* with participants' estimations of the physical formidability of a foe. The more paranoid the individual, the less that they see any single antagonist as posing a threat – and thus the more that they suspect that antagonists are colluding against them, as it is only through collective efforts that such weak foes could endanger the grand actor. This finding may shed

light on the actions of leaders of violent state and non-state entities whose statements suggest the presence of paranoid ideation, as such individuals sometimes exhibit otherwise puzzling inconsistencies in their reactions to threats.

Asset Risk

The third component of threat assessment, the degree to which assets are at risk, is the most challenging to investigate. Whereas many of the studies described above involve experimental manipulation of either aspects of the actor or aspects of the target, the degree to which an individual would suffer costs in the event of violent conflict is not so readily manipulated. Instead, the studies exploring this facet of threat assessment took advantage of naturally-occurring variation in the degree to which study participants' assets were at risk.

Given the profound effect of parental welfare on the health and safety of children, parents can be expected to be more averse to the risk of injury than non-parents. Although the direct costs of injury are equal across parents and non-parents, parents face the added indirect cost of harm to their children's future prospects if injury prevents them from providing for, protecting, and instructing their children. Consonant with this logic, Publication 8 documents that, whether their children are physically present or not, parents conceptualize a potential assailant as more physically imposing than do non-parents. This is the first paper to address parenthood in the context of threat, and one of the first papers to examine the relationship between parenthood and risk sensitivity in general. This work thus establishes parenthood status as an elementary factor in decision-making in situations of potential conflict.

Even absent the physical presence of their children, parents are no doubt constantly cognizant of their identity as parents. This raises the question of whether conscious awareness of

asset risk is necessary for effective threat assessment, or whether such assessments may also take account of information outside of consciousness. Publication 11 addresses this issue by examining the influence of a physiological determinant of asset risk. In women who are not taking exogenous hormones, the probability of conception following coitus is concentrated in a handful of days in the middle of the menstrual cycle. In addition to the physical and emotional trauma that sexual assault entails for victims, the probability of conception is a significant determinant of the costs that assault may impose on them. Viewed in biological terms, reproduction is an asset, and this asset is thus differentially at risk mid-cycle. Publication 11 documents that, correspondingly, menstrual cycle position predicts women's conceptualization of the bodily formidability of a violent offender. Because few women are cognizant of their cycle position, this study reveals the role of unconscious information in asset risk calculations. More broadly, Publication 11 illustrates how examining cognitive representations can be used to investigate factors that contribute to threat assessment outside of conscious awareness – a class of factors that is potentially large indeed.

Potential for Translation to Military Applications

By design, this project employed simple dependent measures. In the studies described above, participants' conceptualizations of the bodily formidability of a target individual or representative member of a coalition were collected using simple pictorial arrays depicting individuals differing in body size and/or muscularity; in literate populations, numerical height estimates were also employed. The research conducted during this project thus abundantly demonstrates not only that the three components of threat assessment (relative fighting capacity, likelihood of attack, and asset risk) and their many constituent parts all employ a simple mind's-

eye image as a summary representation, but, moreover, that, via this representation, these processes can be accessed using elementary methods that require only minimal training to administer, and that can be understood by participants with no formal education. The dependent measures employed in this project are therefore available for translation to a wide variety of military applications. Personnel could readily employ these measures to gauge noncombatants' perceptions of the formidability of opposing parties; to assess the confidence and sentiment of members of allied forces; to measure the efficacy and durability of efforts intended to enhance unit cohesion; to gauge the impact of kinetic or influence campaigns intended to shape enemy morale; and so on.

Performance Metrics

This project was comprised of 36 successful studies, conducted over 45 months, and resulting in 11 published or in-press journal articles, 2 published or in-press book chapters, and 4 under-review or in-preparation papers, as well as additional data that are currently being analyzed. Reflecting the culmination of prior years' investments in data collection, eleven of the seventeen completed items were published or written during the final year of the project. This work has been highly impactful. Google Scholar indicates that, despite their recency, as of this writing, publications from this project have been cited 112 times, with a rapidly-increasing h-index (*X* number of papers that have each been cited at least *X* times) of 7. Datasets that accompany the majority of the published works have been placed in the University of California's publically accessible eScholarship archive (see individual papers for archive access information).

Publications from this project have received considerable coverage by both the domestic and international press, including The Washington Post, The Los Angeles Times, Science, The Boston Globe, The Chicago Tribune, U.S. News & World Report, The Times of London, The Economist (U.K.), New Scientist (U.K.), The Belfast Telegraph (U.K.), The Daily Mail (U.K.), The Daily Telegraph (U.K.), El Mundo (Spain), Tagesspiegel (Germany), The Times of India, the Australian Broadcast Corp., Radio New Zealand, Russia-2 TV, MSNBC, CBS, National Public Radio, and Slate.com, among others.

One postdoctoral fellow, two graduate students, 122 undergraduates, and one high school student were trained in the course of this research. Dr. Colin Holbrook, the postdoctoral fellow, received the UCLA Chancellor's Award, a highly competitive prize recognizing the finest work by a postdoc at UCLA. The two graduate students, Jeffrey Snyder and Matthew Gervais, both completed their Ph.D.s[1]; Dr. Snyder is currently a lecturer at UCLA, while Dr. Gervais held a prestigious postdoctoral fellowship at the SAGE Center for the Study of the Mind at UC Santa Barbara, and recently transitioned to an equally prestigious fellowship split between Rutgers University and Arizona State University.

Publications (published or in-press work, as well as materials under review or in preparation; starred items completed since the last review)

1. Gneezy, A. and Fessler, D.M.T. (2011) Conflict, sticks, and carrots: War increases prosocial punishments and rewards. *Proceedings of the Royal Society B: Biological Sciences,* 279(1727):219-223.

[1] The graduate students' contributions to this project are contained in the published papers described in this report; no separate grant-supported materials appear in dissertations or theses.

2. Fessler, D.M.T., Holbrook, C., and Snyder, J.K. (2012) Weapons make the man (larger): Formidability is represented as size and strength in humans. *PLOS ONE* 7(4): e32751.

3. Fessler, D.M.T. and Quintelier, K. (2013) Suicide bombings, weddings, and prison tattoos: An evolutionary perspective on subjective commitment and objective commitment. In *Cooperation and its Evolution,* K. Sterelny, R. Joyce, B. Calcott, and B. Fraser, eds., pp. 459-483. MIT Press.

4. Holbrook, C. and Fessler, D.M.T. (2013) Sizing up the threat: The envisioned physical formidability of terrorists tracks their leaders' failures and successes. *Cognition* 127(1):46-56.

5. Fessler, D.M.T. and Holbrook, C. (2013) Friends shrink foes: The presence of comrades decreases the envisioned physical formidability of an opponent. *Psychological Science* 24(5):797-802.

6. Fessler, D.M.T. and Holbrook, C. (2013) Bound to lose: Physical incapacitation increases the conceptualized size of an antagonist in men. *PLOS ONE* 8(8):e71306.

7. * Fessler, D.M.T., Tiokhin, L.B., Holbrook, C., Gervais, M.M., and Snyder, J.K. (2014) Foundations of the Crazy Bastard Hypothesis: Nonviolent physical risk-taking enhances conceptualized formidability. *Evolution & Human Behavior* 35(1):26-33.

8. * Fessler, D.M.T., Holbrook, C., Pollack, J.S., and Hahn-Holbrook, J. (2014) Stranger danger: Parenthood increases the envisioned bodily formidability of menacing men. *Evolution & Human Behavior* 35(2):109-117.

9. * Fessler, D.M.T., Holbrook, C., and Gervais, M.M. (in press) Men's physical strength moderates conceptualizations of prospective foes in two disparate societies. *Human Nature*.

10. * Holbrook, C., and Fessler, D.M.T. (in press) The same, only different: Threat management systems as homologues in the tree of life. In *Handbook of Psychological Security,* A. L. Wichman, P. J. Carroll, and R. M. Arkin, eds. New York: Psychology Press.

11. * Fessler, D.M.T., Fleischman, D. S., & Holbrook, C. (in press) Assets at risk: Menstrual cycle variation in the envisioned formidability of a potential assailant reveals a key component of threat assessment. *Adaptive Human Behavior & Physiology*.

12. * Fessler, D.M.T., & Holbrook, C. (in press) Marching into battle: Synchronized walking diminishes the conceptualized formidability of an antagonist. *Biology Letters*.

13. * Fessler, D.M.T., Holbrook, C., Tiohkin, L., & Snyder, J.K. (in press) Sizing up Helen: Nonviolent physical risk-taking enhances the envisioned bodily formidability of women. *Journal of Evolutionary Psychology*.

14. * Fessler, D.M.T., Holbrook, C., & Dashoff, D. (under review). Dressed to kill? Visible markers of coalitional affiliation enhance conceptualized formidability.

15. * Holbrook, C., Fessler, D.M.T., & Navarrete, C. D. (under review). Stature or danger: Racist stereotypes moderate the conceptual links between threat, social status, and physical size.

16. * Holbrook, C., Fessler, D.M.T., & Shaner, A. (in preparation) The Gulliver Syndrome: Grandiosity in paranoia shapes threat assessment.

17. * Holbrook, C., Fessler, D.M.T., & Pollack, J. (in preparation) With God on your side: Religious primes reduce the envisioned formidability of a prospective adversary.