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ORIGINAL ARTICLE

The safe integration of military UAS in the (inter)national airspace: some underlying processes

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Abstract This paper brings a social science perspective (from the ethnicity and diversity literature) to bear on a process that is regarded by many as essentially a technical one: the safe insertion of military unmanned aircraft systems (UAS) in the (inter)national European airspace. The aim of this qualitative study was to gain a more adequate scientific socio-technological understanding of the topic, so as to strengthen issue dialogue and discussion. Indeed, studying the "integration" of these UASs (as this process is often referred to) through the lens of acculturation literature revealed some socio-technological processes that have been little noticed but which seem to underlie and inform this debate. For example, some voices seem to be favoured over others, a well-known phenomenon in the ethnicity and diversity literature. Safety, it could even be argued, is in this debate the pivot point around which social and other dynamics revolve. Belief and power may thus be more important factors here—"masked" of course—than technical aspects of safety. The results of this study are important not only for the military since the incorporation of military UAS occurs, partially at least, in civilian airspace. Civil actors thus formed a substantial subset of those interviewed here.

Keywords Military · UAS · Risk and safety · Socio-technology · STS · Social science

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1 Introduction

The Unmanned Aircraft Systems (UAS) market is expanding rapidly and more and more missions with UASs are being planned and implemented in both national and international airspaces. The military, so far, has operated in designated permanent training areas, or applied segregation creatively (as in using flexible blocks of time and/or space) so as to ensure the necessary training and operational facilities. This, however, reduces the airspace available for other users. There is thus a need to work on some other way to integrate military UASs in the national and international airspace (Tytgat 2014). The safe introduction of UASs (military or otherwise) in the (inter)national airspace may, however, not be so easy to realize (e.g. Ramalingam et al. 2011). The aim of this paper, therefore, is to find out why this would be and so contribute to the science, technology and society (STS) literature, which, as an interdisciplinary enterprise, often studies the social, political and governance dimensions of complex, technological processes such as the introduction of UAS into the airspace (e.g. Grunwald 2011).

Historically, attempts to safely "integrate" UASs (as this process often is referred to) have taken approaches that assume that technological innovation (such as sense/detect-and-avoid technology for UAS) and, to a lesser extent, standardization and regulation efforts will be sufficient to the task (e.g. ICAO 2012a; Eurocontrol 2012; EASA 2012; Loh et al. 2009; Cork et al. 2007). Despite these efforts, however, the debate on how to safely integrate UASs (military and otherwise) has by now acquired some time depth. An alternative—socio-technological—approach is proposed here, so as to consider how social aspects, i.e., social dynamics, may help define and determine this seemingly technologically determined process and the

discussions around it. Such a perspective may be a valuable addition to the analysis of the UAS integration debate since it could perhaps help to reveal obstacles in this process that other approaches tend to neglect. A socio-technological approach could therefore strengthen on-going discussions regarding the integration of UAS technology as it would provide a more adequate scientific understanding of some of the issues that underlie what has often been taken to be a (relatively) simple case of managing trade-offs in the interest of safety (Bakx and Nyce 2013).

This paper reports, in this light, on an empirical study of the harmonized integration of military UASs in the (inter)national airspace, which has been carried out from a socio-technological perspective. More specifically, the issue of UAS integration is approached here from a diversity (or cross-cultural) perspective. The reasons for this specific approach, and for how the diversity literature has been brought to bear to the issue of UAS integration, has been explained in detail in the next two sections, together with some other related features of this research, such as that the stakeholders that have been approached for this study include representatives from the UAS industry, regulators, and operators, from both the civilian and the military domain. The military, after all, although not bound normally by civilian regulations, needs to synchronize with some civilian parties, so as to be able to structurally integrate its UASs in the bigger (inter)national airspace. To give the discussion a focus, the study has looked at the Northern European airspace situation only.

2 Methodology

Researching a topic like the integration of UAS is not so easy to carry out because no "end products" exist yet to investigate. The research has therefore remained confined to the investigation of the UAS integration process itself. This has led us to study relevant documents on the issue, and to carry out 18 interviews with members of a number of relevant organizations and institutions involved in the process. The data gathering focused mainly, but not only, on issues concerning larger military UASs since these normally operate at the same altitudes as manned (military and civil) aviation.

When this study started in 2012 in the Netherlands, discussions there on the integration of military UASs had not proceeded very far yet. The German armed forces, to the contrary, were in the midst of their efforts, at the time, to integrate their Eurohawk UAS into European airspace. However, data on this specific case were unfortunately not available. Although much of the data has been gathered from people involved in the Eurohawk case, this study focused thus on the integration of military UASs in the North European airspace in general.

2.1 Documents

Documentation about the integration of military UAS specifically, especially when it considers another country than one's own, can be difficult to locate. The original safety case document on the Eurohawk, for instance, was not made available for this study. Other documents have therefore been studied, which included documents from relevant regulating and policy institutes in the aviation sector such as NATO, the United Nations International Civil Aviation Authority (ICAO), the European Committee (EC), the European Aviation Safety Agency (EASA), and Eurocontrol (the European Air Traffic Management Organization).[1] The UAS/RPAS Yearbooks (UVS International 2011, 2012, 2013, 2014) were also reviewed, just as were German news articles on the Eurohawk, news articles on UASs in general, and a number of requirements and certifying documents provided by one of the major German UAS manufacturers, Cassidian.

2.2 Interviews

Of the 18 people interviewed for this study, 14 provided in-depth evaluations of the German situation. Four came from the Netherlands and were interviewed for comparative purposes. We used the second set of interviews to check, to some extent, the results that had been obtained on the German situation so that an assessment could be made as to whether the interview instrument and study results could be generalized to other countries. The interview protocol used was semi-structured, which means that interviewees had some freedom to interpret and answer questions as they wished. These interviews focused on issues related to *military* UASs. However, where relevant, attitudes, thoughts and strategies regarding UASs in general were also collected. The interview protocol was sent to interviewees beforehand to allow them to prepare the interview as they desired. The main question asked in the protocol was:

> For safety reasons, should we at all consider the integration of military UAS in the European (inter)-national airspace structure and if so, how can or should we do that safely?

From this question, a number of issues emerged such as the background of the interviewee, their position in the UAS community and operations, and how they perceived the role of the UAS national and international regulators. At the end of the interview, each interviewee was asked

[1] Documents included NATO (2007, 2009), ICAO (2005, 2011, 2012b), EU (2013), and Eurocontrol (2007/2012).

whether there was anything else that should have been carried in the interview.

In an attempt to provide a "complete" picture a broad range of relevant stakeholders was interviewed, including military UAS operators, UAS industry representatives, manned aviators and staff, air traffic managers, and aviation policy makers.[2] In the Netherlands only members from the manned aviation sector were interviewed.[3] All the interviewees were chosen because they can be considered as "true" representatives of their institutions. Civilians like civil airspace regulators also formed a substantial subset of those interviewed here. Civilian decision makers and representatives, after all, are very much part of the debate on the insertion of military UASs as this issue involves, partially at least, civilian airspace.

All the interviews took 1.5 up to 2 h, and all were conducted either in English or in Dutch. With the exception of three interviews,[4] they all took place on a one-to-one basis, two by telephone.[5] The interviews were taped and transcribed, and coded thereafter by using measures for acculturation strategies that a diversity study to be discussed in more detail below.[6] The data set was then recoded using "open coding" techniques (Flick 2009), so as to identify common themes—the social dynamics—that appeared to affect the UAS integration debate. These were included here only when they appeared at least multiple times in the data (e.g. were brought up by different participants or could be found in the documents). As for the ethnicity framework used in this study, the next section will explain some aspects of this framework that the current debate on UAS integration seems to reflect, especially in the policy documents that we collected.

[2] One member of ICAO; two members of EASA; two members of Eurocontrol; one staff member from the civilian German air traffic control organization (Deutsche FlugSicherung, DFS); one staff member from the military German air traffic organization (Amt für Flugsicherung der Bundeswehr, AFsBw); two members of the German Air Force, including one active UAS pilot; three employees of Cassidian, including one active UAS pilot who is released by Cassidian to fly the Heron UAV in Afghanistan for the German armed forces (Cassidian is one of the larger companies that belong to the German military UAS industry); one member of the German Aircraft Owners and Pilots Association (AOPA) representing German General Aviation in this debate; one member of the airline pilots' branch organization (Cockpit).

[3] One member of AOPA NL, three members of the Dutch Airline Pilots' Association (VNV).

[4] One with two members of the EASA, one with two members from Cassidian, and one with three informants from VNV.

[5] One interviewee, for instance, was at the time in Afghanistan.

[6] These included: the attitude towards multiculturalism; the attitude towards newcomers; identification with one's own background, experience(s) and origin; agreement with policies and policy makers in relation to this specific issue; threats and perceived threats related to newcomers such as fears for the own position; intergroup anxiety.

3 Document analysis—the ethnicity framework

Obviously, a central issue in the deployment of UASs (military or otherwise) is how to safely integrate them into the current airspace with its current (manned) "inhabitants." From the beginning, nationally and internationally, and for both the civil and the military domain, two premises seem to be central to this debate, as the UAS policy documents suggest (Bakx and Nyce 2013):

1. UAS must meet the equivalent levels of safety (ELOS) as manned aircraft, and
2. UAS must be able to integrate seamlessly in the current air traffic management (ATM) structure

Over time, a third and a fourth premise has become part of the UAS debate (Eurocontrol 2014):

3. UAS should be transparent to other airspace users and air traffic control
4. UAS should not penalise other airspace use

As this debate has gone on, the requirements for UASs obviously have been raised. Even more, the stakes for the newcomers seem to have been raised repeatedly. Just recently, for instance, UASs have also been required to meet an equivalent *or better* level of safety than manned aviation (Eurocontrol 2014). This, however, is not what we focused on here. What all the premises and requirements imply, implicitly, is that the introduction of UASs in the (inter)national airspace is supposed to rest on the ability of a minority of things in the air (UAS), to act like—or outperform—the majority, i.e., current airspace users. Framing the issue this way does resemble what the ethnicity and cross-cultural literature terms "acculturation strategies": those strategies that people often use in the "…process of cultural and psychological change that takes place as a result of contact between two or more cultural groups and their individual members" (Berry 2005).

Although the idea of acculturation is often applied to a different social domain than the introduction of a new technology such as UASs in the current airspace, there may be more similarities here than one might initially think. The issue of UAS integration, after all, does involve the introduction of newcomers—of non-dominants (UAS)—in a community of already existing, dominant, practitioners and technologies (conventional aircraft). Further, not much imagination is needed to see that, like with ethnicity, these UAS negotiations are a social process that can either change or reinforce previous attitudes and behaviours because of the contact with and perception of "the other group" (Berry 2001). Indeed, the term integration is critical to (and often used in) discussions on the introduction of UASs into the European airspace and many restrictions have been placed upon the UAS community by the current

airspace "habitants". This is a process very similar to how many cross-cultural issues work out in today's society. In short, all, this seems to legitimatize a diversity approach to UAS integration, which has led us to perform a qualitative analysis of the UAS debate from a diversity/ethnicity perspective. More specifically, it led us to look at how the social science literature generally has dealt with the issue of diversity in society, and how this could be used to analyse the issue that we are interested in here, i.e., the introduction of UAS into the European airspace. In the next paragraph, the specific framework that we used for the analysis is described, which included Berry's acculturation strategies, the fusion model of acculturation, and a number of supposed underlying social mechanisms.

3.1 The ethnicity framework—methods section continued

People can exercise particular acculturation strategies for many different reasons. In an attempt to establish a theoretical framework, the diversity literature was therefore scanned not only for measures for acculturation strategies, but also for its underlying themes and assumptions.

Measures for acculturation strategies were found in Berry's model (Fig. 1), which includes eight strategies and is regarded as the most influential model of acculturation, both inside and outside academia (Arends-Toth and Van de Vijver 2002). Although anthropologists Redfield, Linton and Hersokovits coined the term acculturation in 1936, it was Berry who helped spread the term throughout the scholarly literature (e.g. 1992, 1999, 2005). We thus included Berry's strategies in our framework, together with a more recent model: the fusion model. This fusion model describes elements of the acculturation process that Berry's model does not include, i.e., groups that together create a whole new structure (e.g. Hermans and Kempen 1998; for other references for this fusion model, see Coleman 1995; Padilla 1995; LaFromboise et al. 1993).

Applied to UAS integration, the fusion model allows for the possibility that interaction between the dominants' (conventional aircraft) and the non-dominants' (UAS) behaviour(s) could lead to something completely new. Such dynamics are important to notice because the members of the new system, after such a transformation, will have to reconsider even what it regards as its most fundamental values and norms (among which those related to safety). Existing norms and values will be altered in this process rather than modified, as the establishment of new norms and values requires more than just adding up existing ones (Moore 1903). Also, it has to be thought through how these new norms and values should (and could) be understood and addressed in this new system by all those involved.

A large quantitative diversity study was used to illustrate the linkage between the underlying social processes in the UAS integration and acculturation strategies. This particular study assessed diversity attitudes in the Dutch armed forces (Rietveld et al. 2012) and included a large review of the literature. Furthermore, it assessed, using questionnaires, this group's attitudes regarding diversity, rating them using a number of quantitative scales. It turned out that almost any item mentioned in this study could easily be "translated" into a UAS integration issue. Examples of this can be found in Table 1.

The first example comes from a questionnaire that measures perceived threats by majorities regarding minorities, and the second example is one that measures attitudes towards acculturation policies. In order to ensure the congruence between the original survey and the extrapolated version of the items (to the UAS domain), both have been checked against the other by one of the authors of the original study. Some of the translated items

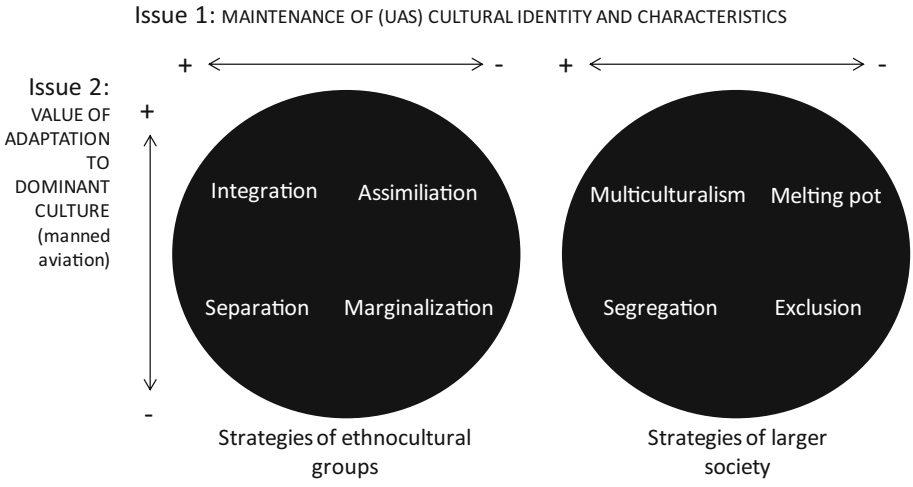

Fig. 1 Berry's acculturation model (Berry 2005)

Table 1 Examples of items translated from a diversity study to the UAS integration issue

1	Original text	"I sometimes worry that my financial position will regress the coming years"
	Translated	"I sometimes worry whether I will still have a job in the aviation sector in a couple of years"
2	Original text	"The Dutch defence organization does enough to counter the discrimination of ethnic cultural minorities"
	Translated	"Regulators put sufficient efforts in countering the discrimination/disadvantage of UAS"

helped to measure the sample's "preferred acculturation strategy(ies)" (Andriessen and Phalet 2002) in the context of the insertion of UAS. Other scales have been used to assess related processes and attitudes and included: the attitude towards multiculturalism (Berry 1997; Berry and Kalin 1995); the attitude towards newcomers (Andriessen and Phalet 2002; Berry 1997; Berry and Kalin 1995); identification with one's own background, experience(s) and origin (Rietveld et al. 2012); agreement with policies and policy makers in relation to this specific issue (Glastra 1999); threats and perceived threats as a result of the newcomers (Eisinga et al. 2005; Stephan et al. 2000, 2002); intergroup anxiety (Stephan et al. 2000).

The transformed items were used to structure the interview protocol and were later used for coding purposes. The measures identified this way formed the lens through which the data have been analysed in this study, which resulted in the analysis that is discussed next. Of particular interest here is how words like integration underpinned and influenced these communities' efforts to incorporate UASs in the airspace safely.

4 Analysing the integration debate

At the onset of this study, the issue of how to safely integrate UAS technology in the (inter)national airspace seemed to be just that; a technological issue of how to structure the airspace such that both current users and UASs (military and otherwise) can use it together safely. In effect, the problem was reduced to and regarded as a relatively simple and solvable case of compromise and standardization if, at least, the aviation community would reach an agreement regarding a few numbers and safety procedures. Only when the topic is explored more in-depth, as this study's results show, some of the actual complexities and difficulties are revealed.

One example concerns the lack of progress in the establishment of airspace regulations. The UAS industry, it seems, is waiting for regulations to inform them what they are allowed to bring into the airspace. This seems quite straightforward. The regulators, however, want at the same time for the UAS industry to demonstrate what UASs are capable of so as to build appropriate regulations. The innovation of (mainly civilian) UASs, as a result, seems to have come to a standstill in some respects. The resulting lack of a solid business case did not help here either, as quite a number of interviewees reported. A second example considers the "detect-and-avoid" equipment,[7] for instance, is often mentioned in this debate as a key factor for establishing safety in an airspace in which both manned aircraft and UASs are present. This argument, however, seems to be informed mainly by "exactly" matching the UASs' technical specifications with existing technology, i.e., with "see and avoid" in manned aviation.[8] Today's (manned) structures, procedures and technology thus seem to both inform and constrain the debate on the issue. One possible result of this is that what UAS technology will look like in the future rests, for a large part at least, on having UAS characteristics match what we already have in manned aircraft, regardless whether this is the most effective (or safe) thing to do.

Here the technological and social processes and domains regarding UASs are so intertwined that it is sometimes difficult to tell them apart. This supports the socio-technological approach taken in this study. What this also suggests is that social and technological acculturation processes have much in common, and this argument seems even stronger when we note how well many of the informants' statements reflect the diversity theme:

1. "We're here first. And I think we are using the airspace safely. And, if somebody else wants to come… I think you've got to accept the standards that are there where you want to go. Like in everyday life … We don't want to be stuffed into reservoirs, like the red Indians in America."
2. "It is like… imagine a group of people, people knowing each other, and you are new… At the beginning, you better shut up, oke, and say, don't worry, I will be here, you will never know I'm here. And that's the best way, actually, as a newcomer, to be accepted."

It would not be hard to assume that these statements were collected during interviews about sociocultural processes

[7] Detect and avoid equipment includes technologies such as sensors or radars that should be able to detect other aircraft as to avoid collision.

[8] In manned aviation, the pilot is ultimately required to "see and avoid" obstacles like other aircraft, especially when operating in airspace where traffic is operating without the help of air traffic control.

related to ethnicity and diversity. The literature on (social) acculturation strategies thus seems to provide a foundation—in an analytic sense at least—for how interpretations and ideas on current and future technology (here manned and unmanned aircraft, and the airspace structure) can emerge and are discussed. Indeed, the data analysis showed how the rhetoric related to social acculturation and exclusion sometimes inform these discussions in ways that can make it difficult to deal with technology change and innovation in any rational way. In fact, a large number of these myths as we have called them here were found to underlie the UAS discussions and negotiations. In the following paragraphs, we give some examples of this (see Table 2 for an overview), starting with a discussion of the integration-myth. Quotations from this study's interviews have been added (in italics) where relevant.

4.1 The integration-myth

In the data analysis, we found the interviewee statements to fit remarkably well with the "translated" measures derived from Andriessen and Phalet's (2002) bi-dimensional scale for measuring preferred acculturation strategies. 13 out of 14 interviewees seemed to prefer a strategy that much resembles the assimilation/melting pot strategy ("Part of it is, of course, fitting into the current system."; "You have to act like a manned aircraft."). 3 out of these 13,[9] however, appeared to prefer segregation when military UASs were concerned.

It may not be much of a surprise that those with a commitment to manned aviation prefer a segregation or melting pot strategy, strategies in which they can remain dominant. It is surprising, however, to notice that members from the UAS community (5 out of 5) also generally support these strategies by embracing the non-dominants' variant, i.e., assimilation ("The easiest way, the fastest way, to integrate UASs in the airspace is to use the current system."). Some of them, however, nuanced this preference. One, for example, saw assimilation as a best initial strategy, necessary for UASs to be accepted ("It would be unrealistic to make a whole change to the system … equivalence is just the entry card."). Two others saw the UAS community as essentially being forced into this strategy ("Unfortunately we are the new kid on the block."). What is remarkable here is that, although the safe introduction of UASs is widely referred by those involved (and by the interviewees as well) as the UAS *integration* issue, none of the informant data showed anything that would directly fit in the integration category. It seems instead that the notion of integrating UASs is more an ideological commitment, an underlying belief, regardless of the actual social process these actors themselves are involved in.

However, taking a position of assimilation—no matter how implicitly—can shift the debate in ways that are difficult to trace, let alone for others to address or critique. It may even be that the existence of this unacknowledged incongruence between assimilationist and integration positions is the reason that, despite much time and effort, this UAS debate has still not been resolved. Further, consider the consequences that an assimilation/melting pot would have on how this debate might get resolved. In the paragraph on responsibility-myth below it has been described, for instance, how the burden of UAS integration is placed on one party more than the other. First, however, we will discuss another dynamic at work in this debate, the substitution-myth.

4.2 The substitution-myth

The substitution-myth identified here is one expression of the fusion acculturation model described in this paper's methodology section. Implicit in this position is the idea that the introduction of any number of UASs into the airspace will change the airspace system, its fundamental values and norms, and also the operations within it. It is generally believed in the UAS debate that, as long as UASs act as any other (piloted) aircraft, i.e., as long as a melting pot strategy is pursued, it will be safe for UASs to share the airspace. Since UASs can never be made to act (exactly) like manned aircraft, however, this assumption seems to rests on what elsewhere has been termed the substitution-myth; the apparent—but false—belief (applied originally to engineers by Sarter et al. 1997) that human activities can be substituted by automation "without otherwise affecting the operation of the system" (Christoffersen and Woods 2002, p. 3).

In the UAS integration debate, the substitution-myth thus holds that UASs can be added to the airspace without the airspace evolving into something new. In reality, however, such "substitutions" actually add another factor to the system, which will redefine the system, and thus its most fundamental values and norms also (among which what safety is). Tasks, roles, duties, and responsibilities within the system will change accordingly. So what seems to be a simple substitution of one thing [UAS] for another [a manned aircraft] can, to a greater or lesser extent, impact the system as a whole, resulting at times in a completely different system. The fusion model may thus be a better framework to discuss the incorporation of UASs into the (inter)national airspace. After all, the interactions between manned and unmanned aircraft will qualitatively differ from those between manned aircraft alone, and this could totally redefine what airspace (as a system) is and means.

[9] With a background in policymaking and air traffic management.

Table 2 Overview of myths identified and their anticipated effects in the UAS debate

Integration-myth	
Description	The notion of integration in the UAS debate seems to be an ideological commitment, a belief, as none of the actors involved in this debate really seems to support this position
Anticipated effect	This shifts the debate in ways that are difficult to trace, let alone for others to address or critique
Substitution-myth	
Description	The apparent—but false—belief that it is possible to substitute one thing [UAS] for another [a manned aircraft] without having to reconsider the system's most fundamental values and norms (among which the value of safety), i.e., without the airspace evolving into something new
Anticipated effect	The denial of the airspace transforming into something new distorts any discussion on safety and tilts the debate into the direction of manned aircraft
It's-all-an-air-traffic-management-problem-myth	
Description	The insertion of UAS in the airspace is often seen as just another air traffic management issue, as how to fit UAS into the current, manned, aviation system
Anticipated effect	To frame the discussion in this way favours some voices in the UAS debate over others, strengthens the dominant position of assimilation in the discussion, and tilts the debate into the direction of manned aircraft
The myth of the perfect person	
Description	UASs are frequently held to match up to or outperform qualitatively stated and flexibly interpretable human performance norms such as see and avoid capabilities so that they are held to norms that humans in reality can in fact not live up to themselves
Anticipated effect	Because the norms for human operators cannot be applied directly to UAS, holding UASs to these norms tilts the debate unfairly in the direction of manned aircraft
Responsibility-myth	
Description	Because in an airborne collision only the manned aviator runs the ultimate risk of dying, UASs are considered to diminish any anticipated decline in overall airspace safety that can be related to the entrance of UASs, as if safety can be achieved through the actions of one single actor
Anticipated effect	This myth tilts the debate, once again, in the direction of manned aircraft as it puts the burden for airspace safety in the new system in which manned aircraft interact with UASs almost entirely on the shoulders of the newcomers, the UAS community

The hold that the assimilation model has on this debate and those involved, however, has led to more than some of the stakeholders to attempt to deny this: "The process is, of course, not to create something new." Much the same sentiments were expressed by EASA staff: "For us, the rules of the air, the airspace classification … and the air traffic control, will remain basically as they are today … and, unmanned aircraft need to comply." Other dynamics, such as acceptance, may be at work here too such as the following strings from another interviewee suggest: "Don't change the existing system … Because of acceptance."; "I think to start totally fresh [as in rebuilding the airspace], Bwoh..!!!!" Acceptance and fear too, obviously, have a role in this debates, just as power does, which can be illustrated by how another informant described what a new aviation system might possibly look like: "[Me:] Why not have the ATC controller have some control input into the aircraft? [Y:] Woohoo, this is, this is really far away from now, but euhm… why not? [laughing] … but … with the structure we have right now, with the people in charge, difficult."

In the same sentence sometimes, informants would even both acknowledge and deny that the substitution-myth plays a central part in the UAS debate: "[Me:] Can we keep the [manned] aviation system intact [after the introduction of UASs]? [X:] Yes!; Me: As a closed system? … Hmhm! [as in yes] … We have to wait until the system collapses, very simple." Here an informant denies, initially at least, that the substitution-myth has any role in the UAS debate by claiming that the aviation system can remain intact after UASs have been introduced. At the same time, he also acknowledges that, that airspace system, due to a lack of capacity, cannot handle UASs and so will fundamentally change to the point of collapse. This is exactly what Sarter et al. warned engineers would happen (and this did occur when the Traffic Collision Avoidance System, TCAS, was introduced [Bakx and Nyce 2013]). In short, not recognizing the role that the substitution-myth, like the integration-myth, plays in the UAS debate will distort any discussion of safety in this debate.

4.3 The it's-all-an-air-traffic-management-problem-myth

Another social mechanism the ethnicity literature discusses is the identification of the self with one's own background,

experience(s) and origin (and from there, judging others). This mechanism seemed to occur in the UAS debate as well, as one informant explained: "Yes, we [Air Traffic Management, ATM] think in manned structures and if you fit the unmanned aircraft in the existing ATM system, or the ATM world, of course you fit into the manned aircraft." The perspective that ATM actors tend to hold is historically connected to manned aviation and this congruence with the current airspace "inhabitants" may be why others in this discussion regard UAS integration as an ATM issue also: "Why should we [manned aviators] make the work for the guy sitting on the ground [Air Traffic Controller, ATC] much more difficult?" In short, the UAS debate not only relies on an integration- and a substitution-myth, but also, on an it's-all-an-air-traffic-management-problem-myth. What these myths do is they frame the discussion so that it favours some voices over others. It selects out and strengthens these voices (by rendering them seemingly more rational and logical), and it establishes and reinforces, in this way, the dominant position of assimilation in the discussion. This, in turn, legitimatizes a central element in this debate, the principle of similarity, i.e., the best, "safest", way to proceed is that UASs duplicate manned aircraft in some absolute sense: "From the ATC perspective, there is not much difference between manned and unmanned". Although reasoning from one's own background can seem logical, and even almost inevitable, this can turn the UAS debate into directions in which safety may not be discussed in any rational way.

4.4 The myth of the perfect person

This (mistaken) analogy of UASs with manned aircraft finds, perhaps, its ultimate expression in the requirement that UASs need to be held to manned aircraft requirements for last resort collision avoidance: "see and avoid". This requirement is stated for manned aviators in qualitative terms only and boils down, basically, to that the pilot must be able to "look outside the window very carefully" (ICAO 2005).[10] It is difficult, of course, for UASs to demonstrate anything like this or anything that is functionally equivalent. As well, any use of this analogy tilts the debate—again—unfairly in favour of manned aircraft. This is reinforced even, as the human ability in this regard is generally—but falsely—assumed outstanding. As one interviewee points out: "See and avoid does not work because of the eye ball. It works because of this big sky, because they have professional ATC, and because the chance that two aircraft hit each other are remote." Still, the standards that UASs are expected to meet are encapsulated in this "myth of the perfect person": "For detect and avoid, [UASs] must have a system which should work 100 %."

Although many interviewees acknowledged this incongruence somehow, this did not change the position they took in respect to UASs. Many of the interviewees made this clear in one way or another: "They have to prove that they are as safe or, even better, that they are safer." What this means is that even if technical and/or functional equivalence(s) can be achieved between UASs and manned aircraft in quantitative terms, this would not necessarily be accepted as an airspace "solution." For instance, not a single, vehicle-based, detect-and-avoid sensor technology has been approved for flights in non-segregated areas, even when this technology performed better in many ways than the human eye. Some reasons for this, such as worries about unforeseen consequences, emerged during the interviews: "They have to prove because they are somewhat unknown." Public acceptance of (and fears for) a new technology was also cited for why people were sceptical of detect-and-avoid technologies: "The community accepts humans making errors, but they do probably not accept machines making errors."

Other than objective characteristics thus seem to inform the UAS debate, and both individually and collectively people in the debate seem to tend to raise the requirements (and stakes) for UASs to be inserted into the airspace "safely." The result is that UASs, as "the new neighbours on the block", seem to be saddled with additional, perhaps even unnecessary, technical and policy requirements when compared with manned aviation. UASs are now held by some, for instance, not to decline safety throughout the entire aviation system when they enter the airspace: "[Me:] What do you mean with integration? [Z:] You just fly into the same airspace without degrading the level of safety of that general activity…". While this position could have some merit, there seems to be no objective reason for the technical and regulatory burden to be placed on the newcomers alone. This brings us directly to the next mechanism or myth that has been identified: the responsibility-myth.

4.5 The responsibility-myth

Some stakeholders argue that the position of unequal burden-sharing taken above, a position that is mentioned frequently in the acculturation literature, is necessary for: "If it comes to an airborne collision between a manned and an unmanned aircraft, only the manned part shares this ultimate risk [of dying] … in so far we argued that the risk for airborne collision must go to the

[10] The exact wording in the ICAO document is: "It is important that vigilance for the purpose of detecting potential collisions be exercised on board an aircraft, regardless of the type of flight or the class of airspace in which the aircraft is operating, and while operating on the movement area of an aerodrome".

unmanned part." Even international airspace regulating institutions seem to hold this position, although less explicitly, as the representative of one of them makes clear: "We will not impose any retrofit requirements … on the manned part of aviation because of unmanned aircraft. Equally we will not impose requirements on air traffic management to introduce modifications." This position has even become, as mentioned earlier, Euro-space policy: "UAS should not penalise other airspace users" (Eurocontrol 2014).

When inequality in burden-sharing becomes institutionalized, one has to wonder why such a seemingly arbitrary and unfair position makes sense to those who take part in the process. Perhaps this has to do with the fact that the UAS socio-technological process ignored (or/and discredited) the fusion model as a legitimate framework to address the issue of UAS integration (see the paragraph on the substitution-myth). In this model, the airspace will inevitably evolve into something new after UASs are added. What this model stresses further, however, is that both current and new users have to share responsibility for that what they shape socially and technologically together: a new airspace structure. The current airspace users tend to portray the UAS community instead as newcomers who, like newcomers everywhere, just have to "fit in", i.e., have to learn to play by (and not challenge) the existing rules: "The unmanned aircraft, they are the new guys around the block, and they have to adapt to the rules, unless it is proven that new rules are safer and, and accommodate all users." Instead of accepting a shared responsibility for creating a new environment together, the result is that the requirements for entrance (in terms of policy and safety requirements) get raised and that the burden (the price of admission as it were) is put almost entirely on the newcomers alone, as if safety can be achieved through the actions of only one actor in a system.

4.6 Summary

Despite the time and effort invested in the UASs policy discussion it is clear that many questions and issues central to this debate have not yet been resolved. What should UASs be compared with? What requirements should they adhere to? Should all the parties accept a responsibility for the creation of a joint manned/UAS airspace, or is this an issue only for the UAS community? The answers to these questions depend, among other things, on whose voice frames the discussion. Obviously, this has much to do with power and with how this is exercised in and across institutional and policy settings today and in the future. The models of (socio-technological) acculturation that stakeholders use (and become committed to) has, of course, much to do with power too.

In this paper, we have described a number of mechanisms—in the form of myths—that seem to inform the debate on the introduction of UASs in the (inter)national airspace. As we have shown, these myths help inform the kinds of "integration" argument that participants tend to make and find persuasive. The assimilation (or melting pot) strategy seems to dominate this discussion. It is accepted, even by the newcomers, the UAS community, if only as an initial entry strategy. What legitimatizes this strategy apparently are the myths that we have outlined here. They help, for instance, to mask the uneven attribution of responsibility (one tilted against the UAS community), which pervades these policy discussions. They also help to camouflage the kind of power dynamics that not only give the manned aircraft community the upper hand, but also make their position (on what constitutes airspace safety) seem logical and reasonable, even to their opponents, at least at first.

5 Reflection

A social science approach, borrowed in part from the ethnicity literature, has been brought to bear in this study on the "technological" issue of introducing military UASs safely in the (inter)national (European) airspace. The result is that several myths were identified that seem to influence implicitly and explicitly the UAS debate so that some voices seem more stronger, more reasonable than others—often on the basis of little or no evidence. What we have also found is that social dynamics, path dependency and belief and power may be more important factors in this debate—although "masked"—than, perhaps, safety itself. It could even be argued that safety in this debate is not much more than a pivot around which social and power dynamics revolve; a reference point to return to each time that the debate gets stuck, or goes into a direction that some stakeholders, often the most powerful, are unhappy with.

That individuals and communities resist technological innovations sometimes that challenge their own values and interests is not particularly surprising. Literature from political science, sociology and management science all support this conclusion (e.g. Rogers 1962; Bass 1969). What the ethnicity literature as it is used here seems to add though—as opposed to those other approaches—is that it not only seems able to incorporate dominant group member attitudes (here the manned aviation community), but that it accounts also for minority (non-dominant) attitudes, in this case the UAS community. Diversity, ethnicity, and other such demographic characteristics have been connected to technology before. Demographic differences in the access to information technology (e.g. Mossberger and Tolbert 2003) have, for instance, been discussed in the literature, as have

some of the social barriers that influenced the development of antimalarial drugs (e.g. Trouiller et al. 2002). Also, scholars such as Latour (1987) and Vaughan (1996) have studied scientists and engineering cultures like tribal societies so as to gain access to these groups' deeply rooted values and norms in order to better comprehend their actions and behaviours. Using the ethnicity literature such as in this paper, i.e. using acculturation strategies and its underlying mechanisms to analyse how relevant groups behave when new technology challenges or becomes part of an existing world, has to our knowledge, however, not been attempted elsewhere.

The myths that we identified here emerged from analysing the interview data with an eye on the acculturative mechanisms that appear to inform the UAS discussions. The first two myths, the integration- and substitution-myth, directly relate to an incongruence in acculturative strategies in these discussions. Looking at these myths could thus help to determine how stakeholders believe how policy should be written and resources allocated. The other myths derived from the analysis of the social processes that seem to lie underneath these acculturation strategies. How the safe introduction of UAS is framed, for example, can be connected to the professional role one holds (such as air traffic management) and thus to one's own background and experience. The myth of the perfect person, in turn, seems to emerge from a fear for the unknown and its unanticipated consequences. The responsibility-myth, also, can be connected to fears and anxieties related to the newcomers—the UAS community—as these may come from having possibly to integrate with them *on their terms*. The result of these myths is that new airspace safety standards are largely determined, today, by members of the manned aviation community. The burden, however, of meeting these standards falls almost entirely on the UAS industry. Such attitudes, as ethnicity literature makes quite clear, can be observed in every social community "threatened" by newcomers. Anxiety and fear, all in all, are central elements in this debate, and this will be discussed in somewhat more detail below. Thereafter, the issue of trust and the military will be addressed, followed by a short discussion on policy making and regulations.

5.1 Fear and anxiety

Fears expressed by the interviewees (more often by manned aviation participants in this debate) concerned a fear of the unknown and its related consequences. Within the general aviation community in particular, this seemed to stem, at least in part, from their perception of UASs as intruders who threaten their world, the existing (and presumably very safe) aviation system. General aviation participants, however, were not the only ones to express concerns. In fact, fear and anxiety seems to play a central role in this debate. It, we found, gives legitimacy to the melting pot strategy, as well as that it assures that these informants reject the—better-suited—fusion model for socio-technological integration. It may even be that fear and anxiety underlie all the myths described here. After all, this study's interview data, such as the differences between how manned and UAS aircraft are perceived, the perception of UASs as intruders, the biased UAS flight competence by measuring not just against a human pilot, but against a fictive pilot who can handle any potential challenge thrown at him or her, these all seem to reflect fear and anxiety about the unknown.

The quick scan data mentioned earlier seem to substantiate this finding. There we described that four people from the Dutch manned aviation sector were interviewed to see to what extent the results of this study that had so far been collected in Germany could perhaps be extrapolated to other countries. In these interviews, the fear of the unknown seemed to be present in equal measures, which could mean that fear and anxiety related to the unknown is something that impacts on all parties involved in this debate. Further, since the topic of fear seemed to underlie, in this study, all the obstacles in the UAS debate described here, other countries may expect to confront similar issues in their attempts to incorporate UASs in their international airspace(s). However, the quick scan data set was too small and included only one other country (the Netherlands) and only one participant set (manned aviators only) so that one should be careful not to draw any definitive conclusions from this part of the research presented here, especially not for countries outside the Northern European region.

5.2 Trusting the military?

Originally, this study focused on issues related to the integration of *military* UASs. It soon became clear, though, that if military UASs are not to be simply assigned a separate airspace (segregation/separation), they become part of the same policy and technical safety debates as other UASs. However, one issue emerged only in discussions of military UAS: the issue of trust. A recent German parliamentary investigation that focused on transparency, the risks and spending associated with their Eurohawk UAS illustrates this concern (e.g. Deutscher Bundestag 2013). In fact, those interviewed for this study mentioned this investigation several times. Air traffic management services staff interviewed here seemed in particular sceptical about whether they should trust the military. This is because, so far, they thought that the German military did not often, when it came to UAS, disclose what they believed to be the necessary operations information. Members of the general aviation sector were also

concerned that if military UASs flights increased in number, they could claim larger and larger pieces of civilian airspace, with general aviation becoming the underdog (and eventual losers).

This issue, and ones related to it like secrecy, we think, are things the military needs to be aware of (and take into account) since it could potentially threaten any attempt to integrate military UAS into European airspace.

5.3 Policy making and regulation

As has been pointed out earlier, the assimilation/melting pot strategy seems to be the dominant acculturation strategy involved in this UAS debate. What most of the interviewees reported (and this is worth noting here) is a lack of progress in policy making regarding UAS integration, even though the study's informants were aware of how difficult the regulators' job may be, and how problematic the issues are that they are confronted with. Such (dis)satisfaction with policies and policy makers can be linked though, if one reads the ethnicity literature, to particular acculturation strategies as the inability to derive policy and regulation—perceived or not—can be interpreted as a passive attitude from the side of the authorities, and therefore as an incentive to preserve the status quo and its attendant inequality (Meerman 2007). This lack of progress in UAS policy making can therefore perhaps account, partially, for the weight that is given to the assimilation/melting pot strategy in this UAS debate, especially when this is coupled to the fear and anxiety that seemed to underlay this debate.

6 Conclusion

Historically, the aviation sector has been seen by itself—and by others—as a safety conscious domain. It can be argued then that the UAS integration debate has a firm base in safety science as well. Indeed, many of its arguments—if not all—do seem to boil down to arguments after safety. The first premise in this debate, that UASs must meet an equivalent level of safety to manned aircraft, is perhaps the most obvious one. What this research suggests, however, is that how safety is treated in this debate could, potentially at least, lead to less safe airspace operations. This is because the discussions in this debate seem to be informed, intentionally or not, by a large number of myths—safety myths, no less.

When we say this we do not mean that stakeholders do not regard safety as central to this discussion. In fact, the one thing that all these stakeholders agree upon is that the aviation system should be safe. Still, what we found is that in the debates the topic of safety represents something like an ideological commitment more than anything else. In other words, the topic of safety in this debate is a trope, a pivot, around which much of the discussion revolves. Safety as a kind of rhetorical Sweden or Switzerland—a seemingly safe haven—one that is important because it commits participants to no actual choice or action, and thus an issue to which participants can (safely) return to again and again in the discussion. The topic of safety in these kinds of discussions, and this has been noted too by Dekker and Nyce (2014), is often both an instrument and a venue for social dynamics and power issues (whether this is acknowledged or not). Only when stakeholders go on to discuss how to preserve an ostensibly safe aviation system which includes UASs, then those involved find out—not surprisingly—that they tend to differ, often substantially, on how to achieve this: "Everyone agrees that we need one equivalent level of safety. But then, as soon as we go one level of detail deeper, we discover that we not necessarily agree."; "The target level of safety … you will find out that until today, although we have been discussing that on the UAS side for years, there is no agreement yet."

The UAS discussions are obviously intended to establish safety in the system. However, the literature on socio-technological systems reminds us that sometimes even seemingly straightforward processes, like the establishment of safety and safety regulations, can contain within themselves mechanisms that may complicate even the most seemingly rational of human processes. Social factors like the construction and enactment of power and myth that we found here can trump rationality and science. Acceptance and fear (of the unknown), as mentioned in the ethnicity literature, can disrupt almost any attempt at an equalitarian or democratic discussion, as can, as we have argued here, any exercise of power, no matter how subtle. All these factors emerged from and, at the same, informed, the interaction of stakeholders, technology and social processes. If the aviation community stakeholders wish to create for all of us safer and more inclusive skies, they may therefore discover that the policy process this involves will be far less technologically driven than they may have anticipated. Both the values and understandings that participants bring to the table may be contested, (re)negotiated and even redefined as the process continues. Also, the decisions and end products that emerge from this process will reflect, negatively or positively, the social mechanisms described here, and by other mechanism which future research might identify. Taking a social science perspective such as the diversity approach used here can, as Giddens (1984) would argue, make these kinds of mechanisms discursively more accessible, which would enable policy and technology scholars, those who mediate for us both equality and hierarchy, to better understand how policy derives not just from some instrumental rationality, but also from some very human social processes. It would furthermore allow us to identify (and critique) the kinds of issues that policy makers often bring to the table but are not aware of.

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