Remotely piloted aircrafts (RPAs or "drones") have become important tools for various applications in military surveillance and combat, border protection, police and disaster management. In particular the use of weaponized RPAs has led to a discussion on the ethical, strategic and legal implications of using such systems in warfare. In addition, studies have suggested that RPA pilots experience similar exposure to post-traumatic stress, depressive disorders, and anxiety disorders compared to fighter pilots, although the flight and combat experience are completely different. In order to investigate this phenomenon, to understand novel forms of human-computer interaction and to inform the discussion on the ethical use of such systems, we have created an experiment that intends to measure the "moral stress" RPA pilots may experience when the operation of such systems leads to human casualties. The experiment includes an RPA simulation based on a game engine and novel measurement tools to assess moral reasoning. Here we outline the design of the experiment, the results of pretests that demonstrate the sensitivity of our measures for the purpose of our study and preliminary results of the ongoing main study.

Measuring the Moral Impact of Operating „Drones" on Pilots in Combat, Disaster Management and Surveillance

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Introduction

Research on human-RPA interaction concerns the efficiency of RPA operation and thus capacities like executive function and cognition. But several studies (references see paper) indicate an unforeseen impact on RPA pilots. They report anxiety, depression, and post-traumatic stress induced by constant exposure to high-resolution images of real-time killing. A study by the US Armed Forces Health Surveillance found that, among RPA pilots, the incidence of stress disorders is similar to those who pilot manned aircraft.

Hypothesis

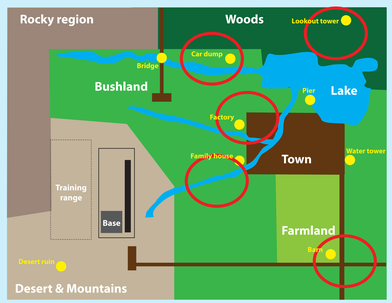
We suggest that "moral stress" may partly explain these findings. We conceptualize "moral stress" as being involved in decisions with high moral relevance without physiologically experiencing the situational factors that allow for "dealing" with the consequences. We furthermore suggest that these decisions have the potential to change the evaluation of values and reasons that are relevant for the decision problem. In our experiment, we have adopted the Trolley Dilemma, where people can benefit one or more persons (of different social rank) at the cost of harming others – and we have embedded it in three scenarios (military, disaster management, surveillance) where RPA pilots operate a simulated drone in defined missions. We hypothesize that tragic decisions that are embedded in a military context (compared to other contexts) will change moral reasoning (captured by value and reason evaluations) more strongly and will be significantly more associated with stress measures both during the operations as well as justifications of actions during a mission debriefing.

Methodology and Setup of Simulation

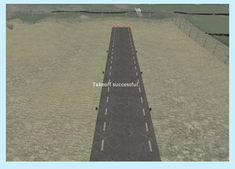
Our study consists of a between-subject-design that includes five steps outlined in the Table below. Our methodology involves not only several measures for stress components (perceived stress reactivity, heart rate) and traits, but includes novel measurement tools to assess moral reasoning. The whole experiment takes part in an acoustic booth that includes a large 60' LED monitor to ensure immersion. The simulation was created using Valve Software's Source SDK Base 2013 game engine and development tools.

Step 1	Preparatory phase: informed consent, briefing, installation of the participant in the experimental booth		
Step 2	Survey part 1: General information, state and trait measures		
Step 3	Condition 1: Military combat	Condition 2: Disaster mgmt.	Condition 3: Surveillance
Step 4	Survey part 2: reason and value test, state measures		
Step 5	Debriefing using a semi-structured interview		

Our participants will have the role of the RPA pilot, i.e. they will guide the RPA to the optimal launch point of the missile and they will keep the target in crosshairs. They do not decide whether the target is legitimate (task of the sensor operator) nor do they launch the simulated weapon, a missile (task of the mission intelligence coordinator); however, they can shift the missile target to an alternative target (resulting in collateral damage).



Outline of the simulated landscape. Circles indicate missions.



Simulated take-off. Prompts (audio and visual) guide the pilot during the training and mission phases.

Outline of a dilemma situation in the disaster management (forest fire) scenario.

After making decisions, the pilots have to approach the scene and confirm casualties.

We used three scenarios to disentangle the effect of immersion alone (surveillance) from different intentional settings: in the military setting, the pilot is involved right from the beginning in a "kill mission", whereas in the disaster management setting, the decision results from an accident. The participants are randomly assigned to either scenario.

Preliminary Results

The study is ongoing, we report preliminary results of in total 38 participants (24 military scenario and 14 firefighter scenario):

- There are remarkable differences in the decisions made: soldiers are much more often sacrificed in order to avoid collateral damage (e.g., 83% spared a family member in the military setting compared to only 43% in the disaster management scenario).
- Pre-post aggression comparison shows an increase only in the military scenario.
- So far, no significant scenario-related differences show up in moral reasoning, but non-redirecters (killing five for saving one) show several significant differences (e.g. obedience is considered to be „more moral").