DEPARTMENT OF PSYCHOLOGY
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PhD course in Cognitive Psychology, Psychophysiology and Personality

(XXIV Cycle)

Thesis submitted for PhD degree

Deciding Under Pressure

How Emotional States Modulate Cognitive Control Components Affecting Performance

(A Police Officer's Perspective)

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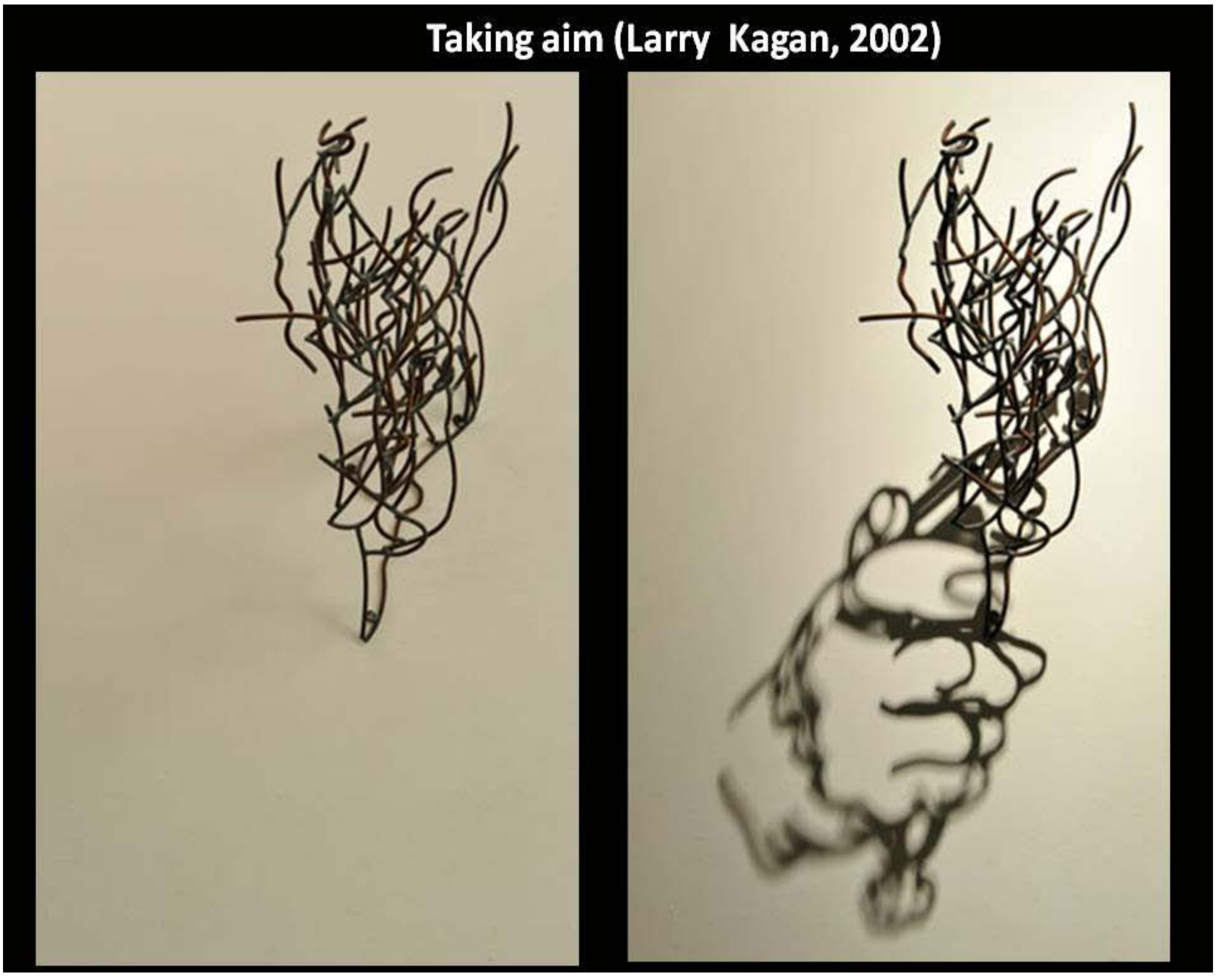
To my wife Arianna, my daughter Giulia, and my son Giordano

"We are more or less aware of the presence of shadows, since they tell us something about our environment, but we do not actually look at them – unless they call attention to themselves by some unfamiliar or unexpected behavior. My challenge was to induce viewers to actually look at the shadow rather than solely at the steel. I began shifting more of the narrative burden to shadow. The more content the eyes could detect in the shadow, the more time and attention they would expend on exploring its details…"

Larry Kagan (2009)[1]



[1] Larry Kagan is a sculptor who uses steel, light and cast shadow as a creative medium (http://larrykagansculpture.com/artist-bio/).

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Abstract

Cognitive psychology research focused on the relationship between automatic and controlled cognition referring to split-second decisions (Payne, 2001, 2006) and examined the effect that race as an ethnic group factor leads to a response *bias* in shooting decisions using videogame-like tasks (Correll, Park, Judd, & Wittenbrink, 2002; Correll et al., 2007). A ***weapon bias*** was reported in judgement denoted as a perceptual weapon-tool classification (Payne, 2001, 2006) and as a *behavioural shoot-do not shoot decision* (Correll, Park, Judd, & Wittenbrink, 2002; Correll et al., 2007; Greenwald, Oakes, & Hoffman, 2003).

The aim of this research was to investigate the impact of arousal, valence and content of IAPS pictures on measures of perceptive sensitivity (***d'***), response bias (***c***) and reaction times (RTs). Two Weapon Identification Tasks (**WIT**) and two First Person Shooting Tasks (**FPST**) were performed manipulating emotional and arousing contents of visual stimuli.

Findings are consistent with the hypothesis that affective modulation influences response *bias* activation and performance, and that content of stimuli amplifies the effect size.

Keywords: Shooting Bias; Weapon Bias; Emotion; Cognitive Control; Decision-Making; Stressful Situations

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Preface

Why "A Police Officer's Perspective"? The answer is twofold.
First of all, because I am a police officer interested in researching in the decision-making domain, especially in highly stressful situations and under pressure. Moreover, I am interested in how performance and cognitive control are impaired by emotional states.
Second, thanks to some early advice from one of the researchers I had the opportunity to get to know at the beginning of this research: B.K. Payne, Professor at the Department of Psychology, University of North Carolina at Chapel Hill, who replied to my request for information about his studies in object misperception as follows.

> Dear Lorenzo,
>
> Thanks for your note. If you have not already read it, you might be interested in a paper of mine (Payne, 2005) that looked at the relationship between weapon identification and measures of implicit and explicit attitudes. As for other implicit methods, you might find my AMP (Payne, Cheng, Govorun, & Stewart (2005) useful (you can download the papers at http://www.unc.edu/~bkpayne/publications.html). Other papers such as those by Josh Correll have looked at measures of stereotypes as predictors also.
>
> Given your police experience I think you might be uniquely qualified to address where such lab studies capture important real-life effects, and where they fail. I'd encourage you to use your police experience to add something new to how these findings are understood. I was once told by a police training officer that when officers are in a high-stress, life-or-death situation, the physiological stress reaction can make people lose fine motor control. As a result, this department trains officers to operate their weapons with gross hand movements rather than fine finger movements. If such intense stress reactions affect the manual operation of weapons, how must they influence the psychological reactions concerning stereotypes and out-group prejudices?
>
> This is just one example, but my point is that you may have training and experience that other academic researchers do not. You should use that to form your unique perspective on your study.
>
> Best wishes with your study.
> Keith Payne

Thus, the question of *how must intense stress reactions influence the psychological reactions concerning stereotypes and out-group prejudices* is the leading investigation aim of this research and the knowledge *using my police experience to form my unique perspective on this research* is the background framework I moved on.

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Acknowledgements

Part of this research (Pre-test, Studies 1 and 2) was supported by the University of Chicago, by J. Correll (Assistant Professor at the Psychology Department at the University of Chicago), and the Stereotyping & Prejudice Research Laboratory, and performed at the Center for Decision Research (University of Chicago, Booth School of Business).

Special Thanks

My first special thanks go to Professor F.S. Marucci (Professor at the Psychology Department of the University of Rome "Sapienza") for taking a keen interest in my aspirations and honing in on it. I truly appreciate all the time and effort he has put into helping and tutoring me.

I would like to thank also: Professor J.T. Cacioppo for his valuable comments and suggestions; J. Correll for providing me with the space, the tools and the wisdom to realise part of my research (Pre test, Studies 1 and 2); D. Ma for her interest and support of this work. Lab members of the Stereotyping & Prejudice Research Laboratory (Psychology Department at the University of Chicago) for the nourishing environment.

For Study 3 I would like to thank the Director of Campus Universitario Ciels (Padova – Italy. http://www.unicriminologia.it/), Simone Borile, his staff, and the students for logistics and participation.

For Study 4 I would like to thank Tiziana Labellarte for her precious help in collecting subjects for the experiment and the 40 police officers who participated in the research. Moreover, special thanks go to Francesco Ruggirello and Annalisa "Nanni" Brucoli for logistics and for having organized an interesting seminar on shooting decisions and the 13 enthusiastic participants from the Italian Corpo Forestale dello Stato who participated in the research.

Always in my thought are my mother, my father and my brother.

I owe a special debt to my wife, Arianna, who somehow found the energy to support and encourage me keeping me happy, secure, and sane.

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PART I

Affect and Decision-Making

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Chapter I

Decision-Making Models: From prescription to description of decision-making processes

One of the necessary abilities to adapt to environment is the capacity to make decisions. Decisions can, in fact, have important consequences for people's lives (Bonini, Missier, & Rumiati, 2008, p. 15).

How people choose a course of action and how they assess, estimate and infer what events will occur are the same processes we refer to as decision-making processes?

Decision-making (DM) involves processes in which the decision-maker is called to choose among various options while the evaluative reaction to outcomes of assessment, estimation, and inference processes is called ***judgement***, a set of components of the larger decision-making process. The two areas of judgement and decision-making overlap and relate to the wider area of problem-solving.

Problem-solving involves the generation of options and the solution of problems in predictable environments, whereas options are generally present in decision-making and decisions usually are made in unpredictable environments (Eysenck & Keane, 2005).

Prescriptive Models of Decision-Making

Choosing the right option involves a certain grade of arbitrarity of the criteria and the evaluation of conflicting attributes of the multi-attribute alternatives available that is essentially a subjective matter and extended over time (Ranyard, 1990a).

Rationality, *expressed as internal coherence and logical consistency within a system of beliefs and preferences* (Mellers, Schwartz, & Cooke, 1998, p. 449), has been one of the concepts most used, and widely criticized, in the early studies on individual decision-making as a basis for evaluation strategies that could be used in different contexts.

Two approaches of decision-making, which focused on rationality, developed normative models on the classical utility theory premises and are represented:

a) on one side, by the super-optimists, or the *Olympians* as described by Simon (1983) in the eighties who attributed a *god-like rationality* to humans, and the optimists, who described human DM as extremely proficient and optimal;
b) on the other side, by the pessimists, the ***Bounded Rationality Theorists*** (BRT), who proposed that human DM was based on primitive mechanism of choice and was critically faulty and prone to mistakes (Ranyard, 1990b).

The concept of ***bounded rationality*** stressed the idea of a limited information processing capacity in the human cognition. It was shown by Simon (1957, 1978) that information processing is a resources impoverishing task and extremely faulty. Solving efficiently real-world problems could require only limited intellectual capacity, the ability to detect and prioritize problems, and learn from experience, which makes sense from an evolutionary perspective (Lipshitz, Klein, Orasanu, & Salas, 2001).

In any case, the three perspectives mentioned above (Olympians, Optimists, and BRT) share similarities because they describe models that are *organized sequence of information* *processing operations, including evaluative operations, which result in the evaluation of choice alternatives in such a way as to discriminate the best amongst them* (Ranyard, 1990b, p. 289), the Ranyard's definition of Rational Models of Choices.

Moreover, all the models could be represented with a decision tree which describes the environment of the task and that can exhaustively represent the main aspect of DM such as uncertainty and multi-dimensionality of outcomes (Ranyard, 1990b).

The models vary according to the assumptions made about the evaluation and probability judgement processes (either absolute or relative), their metric level, and the information integration process that could be computational or conceptual (Ranyard, 1990b).

Economics and other sciences, such as finances, marketing and other fields, relayed on the ***Rational Choice Theory*** framework (Mellers, Schwartz, & Cooke, 1998) since departures from normative models were documented in the fifties and sixties, and the study of shortcomings used by humans in probability judgement developed in a large body of research: the ***Behavioural Decision Theory*** (Lipshitz, Klein, Orasanu, & Salas, 2001; Ranyard, 1990a).

Later in the sixties, the idea proposed by Tversky (1967) that heuristics such as representativeness, availability, and anchoring, with which a small amount of information is processed, gave the definitive boost for improvements in understanding cognitive processes involved in DM and judgement (Lipshitz, Klein, Orasanu, & Salas, 2001; Ranyard, 1990a).

Interesting developments from normative frameworks attempted to enhance the understanding of the ways judgement and DM are performed by human beings.

Perspective changed from the proposal of rational procedure on how people should make decisions to the description of how people do make decisions.

Descriptive models of decision-making evolved in sub-disciplines and *now we have behavioural game theory, behavioural finance theory and behavioural accounts of law* that account for rational choice violations in real-world and laboratory situations (Mellers, Schwartz, & Cooke, 1998, p. 449).

Another concept widely used among decision theorists is the concept of ***subjective probability*** (Bonini, Missier, & Rumiati, 2008; Rumiati, 1990), one of the subjective concepts that, combined with the personal utility function, built the subjective ***Expected Utility Theory*** proposed by Savage (1954).

The subjective expected utility theory was used by Savage (1954) to explain how preferences depend on the level of subjective expected utility and why people may make different decisions according to their personal utility functions and the subjective beliefs of probabilities of different outcomes (Bonini, Missier, & Rumiati, 2008; Rumiati, 1990).

According to the subjective expected utility, Edwards (1954), in several experiments in the fifties, found that some probability rates were preferred but preferences changed with expected value of a bet and dramatically when expected values were negative.

The behaviour could be explained by referring to the fact that personal evaluations of events could determine a dramatic deviation from the objective probability rates of the results of the event itself.

The principle that people try to maximize their winnings, or the expected utility proposed by von Newman & Morgenstern (1947) in their game theory, was definitively mined by Tversky (1967) who demonstrated that when the decision is to be taken in a context of ambiguity, in which the subjective utility is not completely expressed by the expected utility, the utility theory is violated.

According to Tversky (1967) the utility theory could not explain why some individuals would prefer to bet a small amount of money on low probability to win while others, conversely, could decide to bet a bigger amount of money on a higher probability to win a more modest sum of money.

Moreover, normative theories do not seem able to explain the subjective decision-making process in complex situations where the decision-maker should evaluate different options and express a global judgement.

An explanation of this decision process is attempted with the ***Multi-Attribute Utility Theory*** (Keeney and Raiffa, 1976) that prescribes that once the relative utility of the attributes are computed, the values are summed up and the option with the higher multi-attribute utility is chosen (Bonini, Missier, & Rumiati, 2008; Rumiati, 1990).

Descriptive Models of Decision-Making

In the eighties, among many alternative empirical models that attempted to respond to the inadequacies of the utility theory and to the dominant normative and descriptive model of DM under uncertainty, Kahneman & Tversky (1979) proposed ***The Prospect Theory***.

The key elements of [their] *theory are 1) a value function that is concave for gains, convex for losses, and steeper for losses than for gains; and 2) a nonlinear transformation of the probability scale, which overweights small probabilities and underweights moderate and high probabilities* (Tversky, 1992, pp. 297-298).

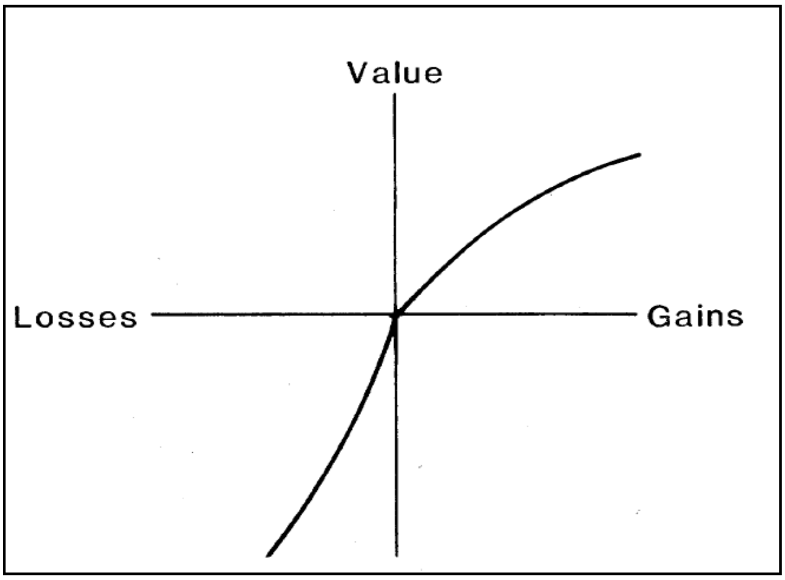

Figure 1. 1 A hypothetical value function (source: Tversky & Kahneman, 1981).

Later Tversky (1992) presented a new version of their theory, ***The Cumulative Prospect Theory***, in order to extend the model to uncertain as well as to risky prospects with any number of outcomes.

The Prospect Theory is applied in situations where choices are made evaluating the known probability of the outcomes but this information is not always available. Thus, uncertainty gets ambiguity connotations and seems to affect decisions (Bonini, Missier, & Rumiati, 2008; Rumiati, 1990).

Using a paradox (***Ellsberg Paradox***), Ellsberg (1961) demonstrated that people prefer to bet on known rather than unknown probabilities, avoiding the risks associated with uncertainty and ambiguity.

Einhorn and Hogarth, who believed *that psychologists can best contribute to decision research by elucidating the basic psychological processes underlying judgment and choice, tried to place behavioural decision theory within a broad psychological context* and *emphasized the importance of attention, memory, cognitive representation, conflict, learning, and feedback*, proposed a descriptive model placing as pivotal the association ambiguity-uncertainty (D.E. Bell, Raiffa, & Tversky, 1988, p. 140).

Einhorn and Hogarth's Model assumes an anchoring-and-adjustment process in which estimation is made at first, and then adjustments are applied for what it is supposed it might be. An initial estimate provides the anchor, and adjustments are made throughout mental simulations, accounting for the ambiguity amount estimated and the personal attitude toward the ambiguity. Thus, a differential weighting of imagined probabilities results in the final choice (Einhorn & Hogarth, 1981).

A little later, Mitchell, Rediker, & Beach (1986) proposed ***The Image Theory***, which takes its roots from the ***Plans Theory*** earlier proposed by Miller, Galanter, & Pribram (1960) (Bonini, Missier, & Rumiati, 2008; Einhorn & Hogarth, 1981; Rumiati, 1990).

The central construct in the Image Theory is how a simple counting rule is sufficient for the assessment of compatibility (Beach & Mitchell, 1987; Beach, Smith, Lundell, & Mitchell, 1988).

The image theory put forward the idea that humans organize their thinking about decisions using three different schematic knowledge structures to represent information as images (Beach, 1993; Beach & Mitchell, 1987).

One image consists of principles, the **Value Image**, that represents the decision-maker's rigid criteria to pursue specific goals. The imperatives of these constituents serve to assess the rightness or wrongness of any particular decision.

A second image, the **Trajectory Image**, represents the future state of events and what the decision-maker hopes. The goal *agendum* of the decision-maker can comprehend concrete events or abstract states and represents the ideal trajectory he/she expects for the future.

A third image, the **Strategic Image**, is represented by plans that have been adopted and implemented in the attempt to achieve the proposed goals. ***Plans*** are anticipation of the future and represent the prediction of what will happen if certain tactics are executed. The concrete behavioural components of plans, the ***Tactics***, are specific actions that are projected to facilitate the implementation of plans themselves (Beach, 1993; Beach & Mitchell, 1987).

A fourth image represents the **Mental Anticipation** of events and states of the plans in the future. The image is the forecasting of results of the plans (Beach & Mitchell, 1987; Bonini, Missier, & Rumiati, 2008; Rumiati, 1990).

According to Beach & Mitchell, the decision-taker uses either *(1) the compatibility between candidates and existing principles, goals and plans, and the compatibility between the images* *of the aspired-to and the anticipated states of events, or (2) the potential gains and losses offered by a goal or plan* (Beach & Mitchell, 1987, p. 201) in order to adopt or reject new principles, goals, or plans, and determine whether progress toward goals is being made (Beach & Mitchell, 1987).

The image theory is recognized as being interesting and ambitious and has been used to explain organizations' DM processes, but needs more specifications to better understand the images' rule in guiding some decisions (Bonini, Missier, & Rumiati, 2008; Rumiati, 1990).

Alternative Models to explain DM in Extreme Events and Emergencies, accounting for Risk and Ambiguity

Other frameworks to better explain violations of rational choice theory have been proposed, considering the faulty assumptions on which normative models are based.

March (1982) proposed a model in which decisions are viewed as more reasonable and adaptive, and choices are considered to be either:

a) ***Preference-Based***, resulting from a prior assessment of beliefs and values of the potential outcomes. In preference-based choices, beliefs are expressed as probability judgement, judgement under uncertainty and confidence judgement;
b) ***Rule-Following***, based on rules or heuristics. In rule-following decisions information conveyed in the decision process may concern habits, personal beliefs, morality or social identity (Mellers, Schwartz, & Cooke, 1998).

Personal and personality variables of the decision maker-influence the decision strategy. In addition, what the decision maker-knows, in terms of decision strategies and their relative promise of success, his/her ability to exercise that knowledge, and his/her motivation, probably, influence his/her strategy selection (Beach, Mitchell, Deaton, & Prothero, 1978).

Furthermore, the decision-maker varies according to other dimensions such as risk perception and attitude.

Risk is a construct that has multi-dimensions labelled as dread, lack of familiarity and lack of control. How people observe the surrounding environment and how they view objects and hazards affect individual risk perception.

Furthermore, risk is a social construct that helps people to cope with daily uncertainty and dangers of life; this makes risk hardly definable, as the concept of safety, because of its extreme subjectivity. For example, according to the gender, ethnicity, and expertise, the perception of environmental hazards is different (Mellers, Schwartz, & Cooke, 1998).

According to economic theories, people seem to be oriented toward low risk acceptance, especially in the gain domain, while they prefer to risk more in the loss domain (Kahneman & Tversky, 1979).

Preferences reveal people's attitudes and, according to their preferences, are roughly classified as:

a) ***risk-averse***, those who prefer the sure thing; and
b) ***risk-seeking*** people, who choose to gamble.

Perceptions of risk vary across domains, but perceived-risk aptitudes are more stable and consistent than risk aptitudes defined by economic theories (Mellers, Schwartz, & Cooke, 1998, p. 453).

However, how people make decisions in particular situations such as in shooting incidents is not completely understood in science because it is not easy to simulate extreme events or emergencies in a controlled setting (Vickers & Lewinski, 2011).
Nevertheless, it seems that situational factors (e.g., time pressure, significance, accountability, irreversibility, etc.), personal characteristics (e.g., self-consciousness, anxiety, expertise, motivation, etc.), and task characteristics (ambiguity, complexity, familiarity, instability, etc.) influence the decision-making strategy (Beach, Mitchell, Deaton, & Prothero, 1978).
The main distinction suggested by ***Dual-Process Theories*** (Jacoby, 1991; Payne, 2001) is between a fast and frugal heuristics intuitive-experimental system and a slow and controlled but effortful information processing rational-analytical system.
Moreover, another important distinction that has been made in neuropsychological decision-making research (Starcke, Pawlikowski, Wolf, Altstotter-Gleich, & Brand, 2011), refers to decisions made under ambiguity versus decisions made under risk conditions.
Ambiguity leads to the activation of the intuitive processes based on expertise due to the lack of explicit rules for the prevision of possible outcomes or probability estimations, whereas ***risk*** is associated with explicit conditions, rules for reinforcement and punishment, and the calculation of potential outcomes needs further information acquisition (Damasio, 1996).

The question is:
What occurs if risk, ambiguity, significance, accountability, irreversibility, complexity, instability are compressed in a split-second (time pressure), and what is the maximum length of time given to activate a decision process where a life or death decision has to be taken?

Naturalistic Decision-Making: Deciding in the Real World under life threat

To understand how humans decide under life threat implies the comprehension of how humans detect threats and which are the neural system's primal circuits that are first activated (Rahman, 2009).
In modern times, responses to stimuli evolved to counter predators and to guarantee humans' survival are used in different contexts, such as facing an adversary or in an adversarial situation where life-threatening situations elicit the orienting-defence response. Fight, flee, freeze or posture are the options humans may choose, with little conscious thought, when under life threat (Rahman, 2009).
The major criticism to normative and descriptive models of DM is that they are based on laboratory tasks, simplified and highly structured, and *have limited utility in operational domains characterized by high time pressure, uncertainty, and ambiguity, continually changing conditions, ill-defined goals, and distributed decision responsibilities* (Klein & Caldenvood, 1991, p. 1018).
Any analysis of human performance in *volatile, uncertain, complex and ambiguous domains and terrains* (Rahman, 2007), such as no briefing on Command and Control, can begin without giving tribute to Boyd's OODA Loop (Brehmer, 2010).
The Dynamic OODA Loop is the dominant model applied to many operative situations

including mission critical domains which was developed by Col. John Boyd (US Air Force fighter pilot; the OODA Loop is part of the Doctrines for U.S. Air Force, Army, and Navy as well as other US and international defence forces).

Boyd's Loop, in its first conceptualization to explain the superior performance of the American pilots in the Korean War, implies four principal activities: Observe, Orient, Decide, and Act (see Figure 1.2).

The wide application of the model to various forms of combat and its natural evolution in a more general model of winning and losing, transformed the classical OODA Loop into a stage model with the introduction of a number of feed-back loops with particular attention to the orient stage and the factors that affect the orientation achieved by the decision-maker (Brehmer, 2010, see Figure 1.3, p. 14).

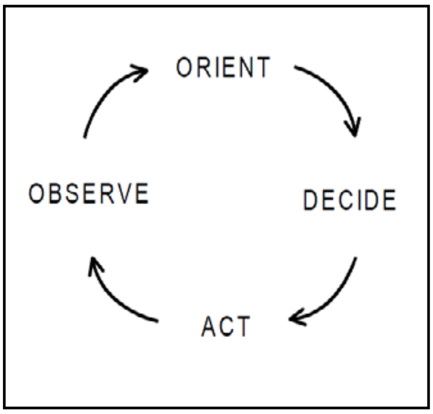

Figure 1. 2 The classical Boyd's OODA Loop (source: Brehmer, 2010).

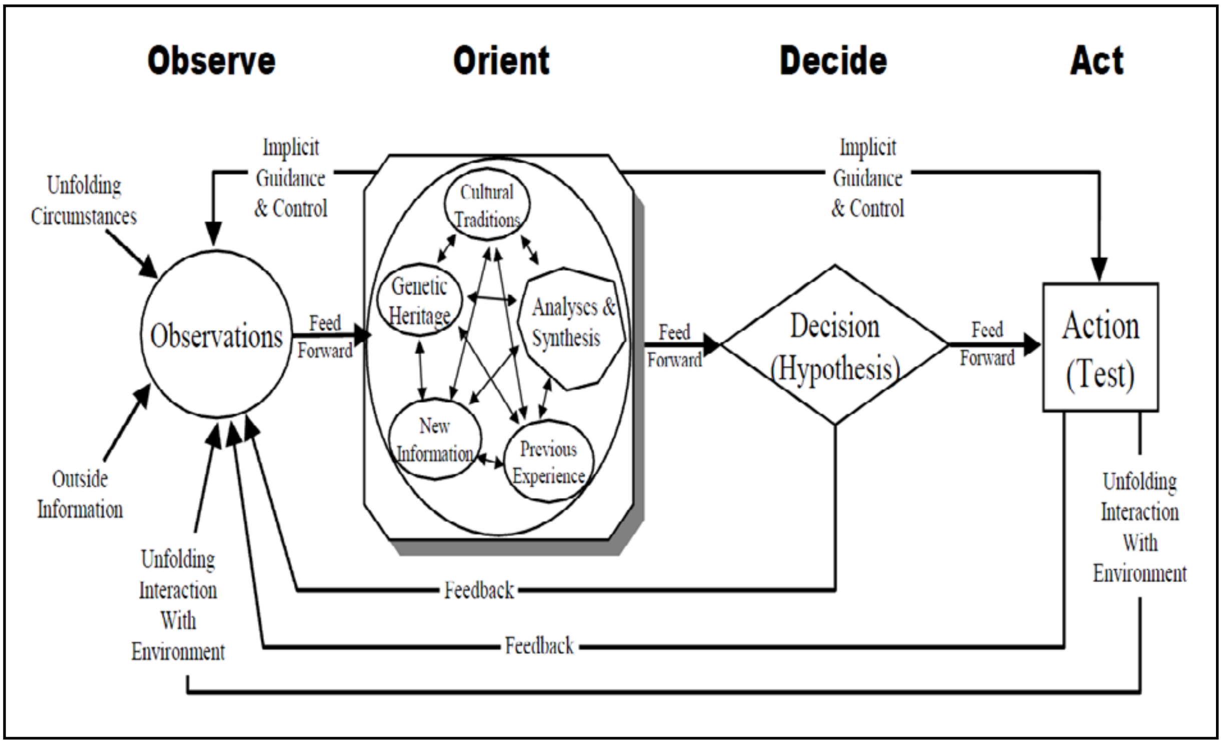

Figure 1. 3 The transformed Boyd's OODA Loop (source: Brehmer, 2010).

Security professionals, low enforcement and military personnel, for service or tactical decision-making in operative or dynamic situations rely on the OODA Loop due to their criticism of decision-making models and their limited applicability to operational settings.
In fact, not all the decisions are equal; some decisions are reversible, whereas others are irreversible and with a high level of significance, such as the decision to shoot, because they could have tremendous implications for the life of the decision-maker and others who are the target of the decision itself.
Moreover, the decision to shoot has a high level of accountability and is usually carried out under uncertainty, time pressure, and constraints. This kind of decision task is defined by Johnston, Driskell, & Salas ***Naturalistic Task***: task in which *decisions are made under time pressure, data are ambiguous or conflicting, the consequences of error or poor performance are costly, and decision-makers are familiar with the task (*Johnston, Driskell, & Salas, 1997).
It seems that in realistic tasks, or naturalistic tasks as defined by Johnston, Driskell, & Salas (1997), decision-makers adopt a simpler analytic strategy more appropriate for these conditions (Beach, Mitchell, Deaton, & Prothero, 1978; Johnston, Driskell, & Salas, 1997; Zakay & Wooler, 1984).
These cognitive strategies are described by Klein to explain how decision-makers are able to cope with time pressure using their experience and knowledge to selectively filter information, and narrowing attention, using heuristics that enables them to process information in order to generate reasonable options and select a course of actions, and eventually implement the first workable solution (Klein, 1996). This new framework, ***The Naturalistic Decision-Making*** (NDM) framework, was initiated by some behavioural scientists in an attempt to understand how people make decisions in real-world contexts, in a conference sponsored by the US Army Research Institute (Dayton, Ohio, 1989).
Essentially, the NDM framework, having the human proficient decision-makers as its basis for prescription and at the centre of its interest, attempts to build descriptive models of DM behaviour in natural contexts without relying on classical decision-making models (Lipshitz, Klein, Orasanu, & Salas, 2001).
Since 1989 eleven conferences have been held all over the world and the definition of NDM and the factor taken in account evolved.
The original mission of NDM promoters was to shed light on five essential characteristics: *proficient decision-makers, situation action matching decision rules, context-bound informal modelling, process orientation, and empirical-based prescription* (Lipshitz, Klein, Orasanu, & Salas, 2001, p. 332).
Expertise and ***knowledge***, included as second factors in the first list of the features of contexts, were soon recognized as primary factors in NDM studies by Pruitt, Cannon-Bowers, & Salas (1997) completing the definition of NDM.
The Proficient-Decision Makers are currently conceived as people who rely directly on their experience and who have relevant expertise or knowledge in the decision-making domain the field settings.
First of all, the main differences between classical DM models and the NDM framework rely on the fact that the conception of making a decision by choosing among alternatives that are available is re-conceptualized with the idea of *Situation-Action Matching Decision Rules*

(Lipshitz, Klein, Orasanu, & Salas, 2001).

Situation-Action Matching Decision Rules labels the process of DM by matching options rather than choosing concurrent ones and the differences rely on:

a) the mode of options evaluation. NDM framework view the proficient decision-makers decide sequentially comparing options one at a time against the preferred one and focusing on only one or few options;

b) the compatibility with the context or personal values and the consequential acceptance or rejection of the option;

c) the matching process that relies on informal logic and pattern matching rather than analytic reasoning (Lipshitz, Klein, Orasanu, & Salas, 2001).

In fact, *it seems unlikely that people can apply analytical strategies in less than a minute* (Klein & Caldenvood, 1991, p. 1018).

Even though, the use of less analytic strategy is considered as an inadequate response by Janis & Mann (1977), who describe it as a ***Hyper Vigilant Decision-Making*** (HVDM) pattern adopted in a near-panic state; conversely, J.W. Payne, Bettman, & Johnson (1988) consider it a strategy that allows decision-makers to perform better on a naturalistic task.

J.W. Payne, Bettman, & Johnson found that, to reach a decision in time, simpler and less analytic decision-making strategies could be used and usually result in a better outcome than *the use of truncated normative procedure* (Johnston, Driskell, & Salas, 1997, p. 615).

This could be evidence of the ability of decision-makers to selectively filter information and to use simpler heuristics to speed the information processing in order to cope with the time pressure adaptively (Johnston, Driskell, & Salas, 1997).

Klein & Klinger (1991) argued that in naturalistic settings extensive analytic strategies are rarely used especially when time is lacking.

In naturalistic settings, time-consuming strategies are substituted by simplified heuristics shaped by experience that help to generate reasonable options, thanks to the ability to identify meaningful data. Therefore, a course of action is selected according to simple parameters and, if needed, the first workable solution is implemented (Klein and Klinger, 1991).

In Klein’s perspective the HVDM model as presented by Janis & Mann (1977) could represent a way to respond effectively and adaptively to naturalistic decision-making tasks and could be shaped by the nature of the task itself (Johnston, Driskell, & Salas, 1997).

To summarize, HVDM strategy, as proposed originally by Janis & Mann (1977) as a deviation from an ideal pattern of analytic decision-making, and an indication of a near-panic state, is seen as a less analytic and adaptive response to situational demands strategy by J. W. Payne, Bettman, & Johnson (1988), and as an abbreviated but effective decision-making strategy by Klein & Klinger (1991).

On the other hand, Johnston, Driskell, & Salas (1997), in a study that examined the effectiveness of *Hyper Vigilant* and *Vigilant* decision-making strategies in a naturalistic task, concluded that *Hyper Vigilant* strategy may be an effective course of action in that particular task setting, contrasting the views, even if optimistic, of J.W. Payne, Bettman, & Johnson (1988) and Klein & Klinger (1991), and the *Hyper Vigilant* strategy proposed by Janis & Mann (1977).

Another characteristic that differentiates NDM from Normative Models is the *process* *orientation* that changes from the attempt to predict which option a decision-maker will/should choose according to his/her preferences (input-output orientation) to the description of cognitive processes utilized by proficient decision-makers. This aspect is particularly interesting in the light of information seeking, decoding, interpreting and the rules proficient decision-makers use Information processing.

Klein & Caldenvood report that decision-makers in emergency events *were not making choices, considering alternatives or assessing probabilities. They saw themselves as acting and reacting on the basis of prior experience; they were generating, monitoring, and modifying plans to meet the need of situations* (Klein & Caldenvood, 1991, p. 1020), and Lipshitz, Klein, Orasanu, & Salas argue that *decision makers in natural settings use situated content-driven cognitive processes to solve domain-specific problems by taking concrete actions* (Lipshitz, Klein, Orasanu, & Salas, 2001, p. 335).

Lipshitz, Klein, Orasanu, & Salas (2001) argue that proficient decision-maker process of information is driven by what they call the ***Context-Bound Informal Modelling*** (as opposed to context-free formal modelling): their experienced knowledge. This is the reason why NDM models, that are empirically-based and aim to prescribe solutions from the empirical analysis of expert performance and the relative descriptive models, tend to be informal and reality-based rather than formal and abstract as Normative Models of DM.

The Recognition-Primed Decision-Making Model (RPDM)

Whereas many models contributed to expand the NDM framework and to develop theories, models and methods of research, as well as applications to better understand the DM process in operational settings, the prototype model is represented by the ***Recognition-Primed Decision Making (RPDM) Model*** (Klein, 1993). This was proposed by Klein the nineties on the observations made on the analyses of fire-fighters' cognitive processes in emergency events (Klein, 1993).

According to Klein (1993), to handle stress and the constraining of operational field characteristics, such as time pressure and uncertainty, decision-makers mostly rely not on comparison of options but on the first course of action which comes to mind.

Klein (1993) believes experts may make decisions without relying on options' comparison by two main processes described in his RPDM model. The two processes are:

a) ***Situation Assessment***, that allows the classification of the situation as typical or familiar, and

b) ***Mental Simulation*** for the evaluation of the actions.

The RPDM Model is not proposed as an alternative to analytic frameworks but as the end of a continuum in which at the other end there are recognitional and analytical decision strategies (Klein & Klinger, 1991). As better explained by Klein & Klinger, *at one extreme are the conscious, deliberated, highly analytic strategies such as MAUA* [Multi Attribute Utility Analysis] *and Decision Analysis. Slightly less analytic are non compensatory strategies such as elimination-by-aspects. At the alternate end of the continuum are Recognition-Primed Decisions (RPD), which involve non-optimizing and non-compensatory strategies and require little conscious deliberation* (Klein & Klinger, 1991, p. 18).

The RPDM model attempts to explain how experts take rapid decisions with three variations. The first condition is represented by situations promptly recognized and in which the course of action to be implemented is obvious (**Typical Action**).

Familiar or prototypical situations are recognized:

a) processing information concerning goals, whether they are plausible or not;
b) monitoring cues, especially critical ones; and
c) foreseeing the expected outcomes (Klein, 1993).

When typical action implementation is not the immediate response but adaptations are needed, some more conscious evaluation is carried out by the decision-maker.

Potential problem detection is performed by mental simulations and eventual adaptations are applied to the typical action to make it work properly in the situation (Klein, 1993; Lipshitz, Klein, Orasanu, & Salas, 2001).

When typical action or the consequent adaptations are not considered adequate and they are rejected to evaluate the second most typical action, it means the situation is complex and modifications to the evaluation that revealed weakness or flaws are needed. In this case evaluations are implemented throughout mental simulations to evaluate the probability of success and to detect eventual unacceptable consequences (Klein, 1993; Lipshitz, Klein, Orasanu, & Salas, 2001).

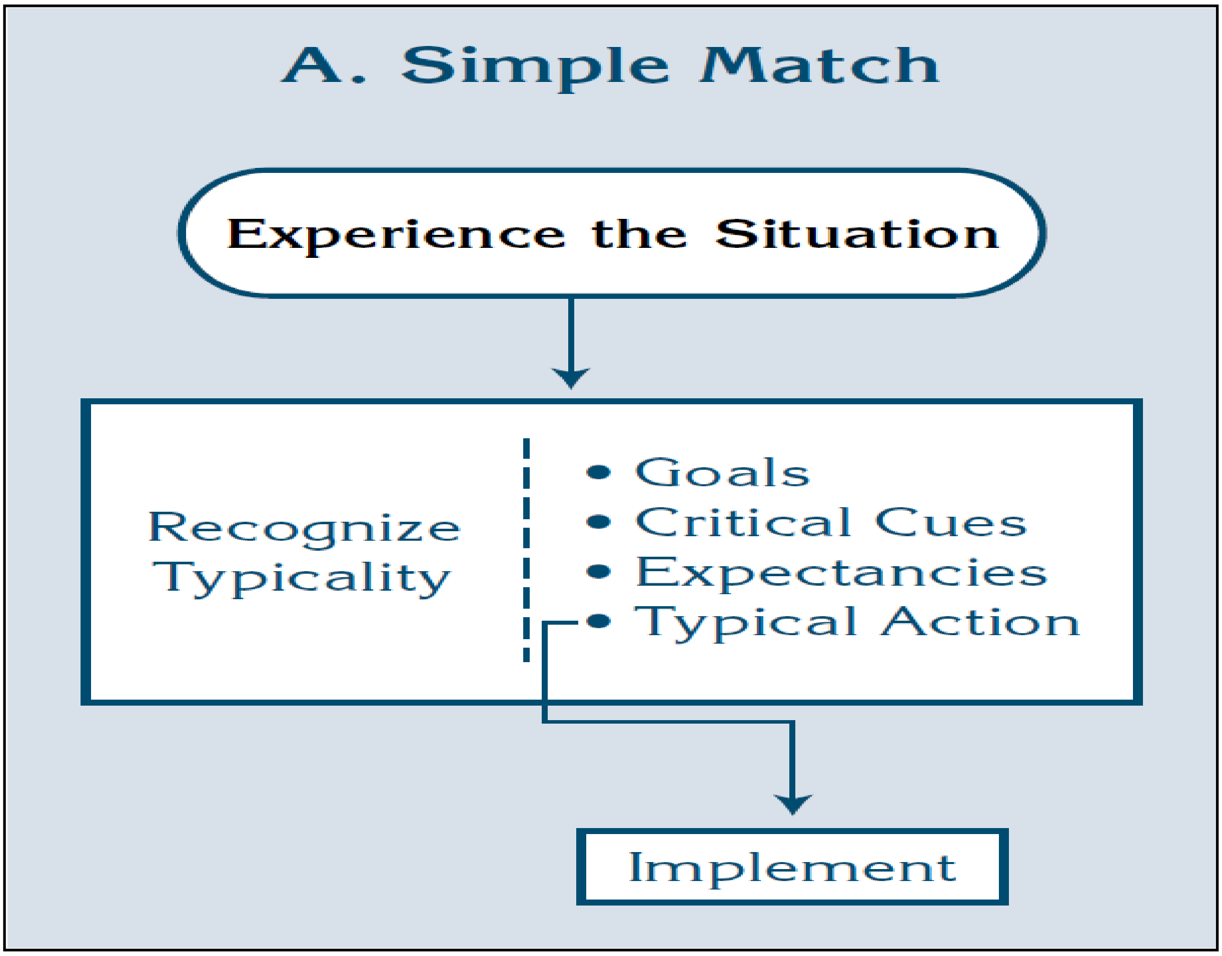

Figure 1. 4 Typical Action (source: Klein & Klinger, 1991).

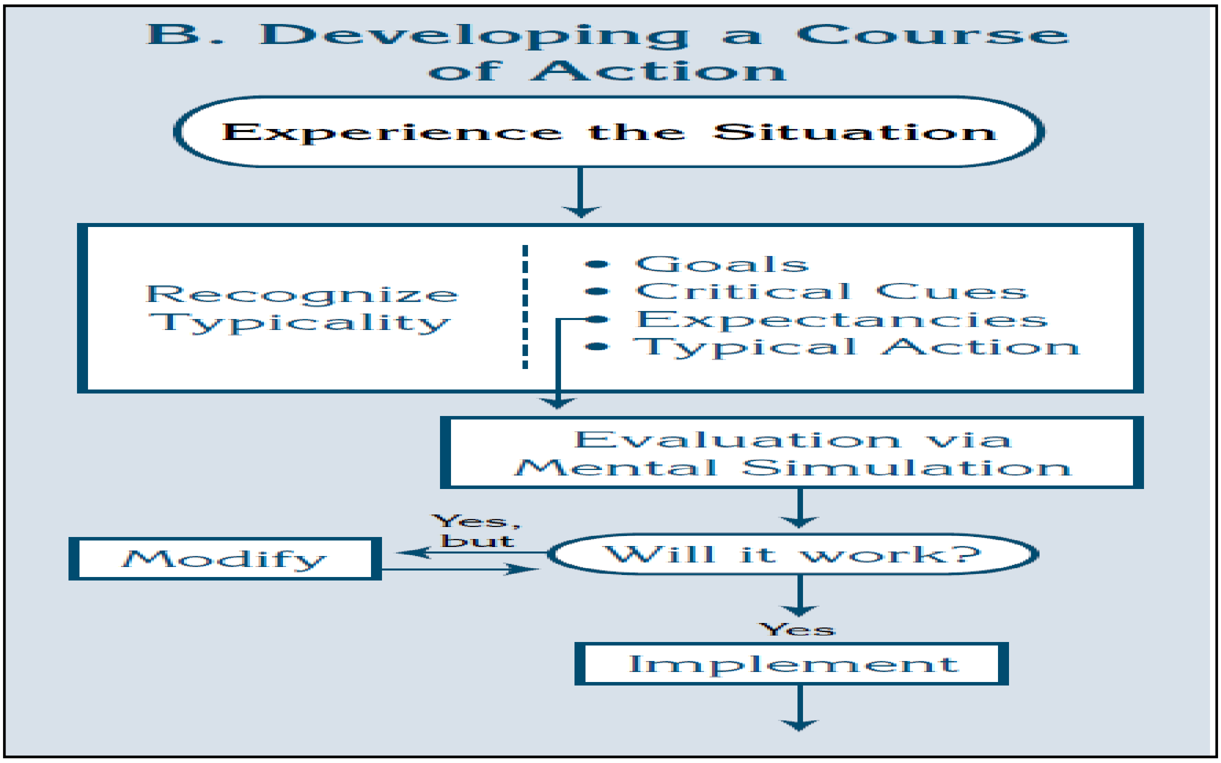

Figure 1. 5 (source: Klein & Klinger, 1991).

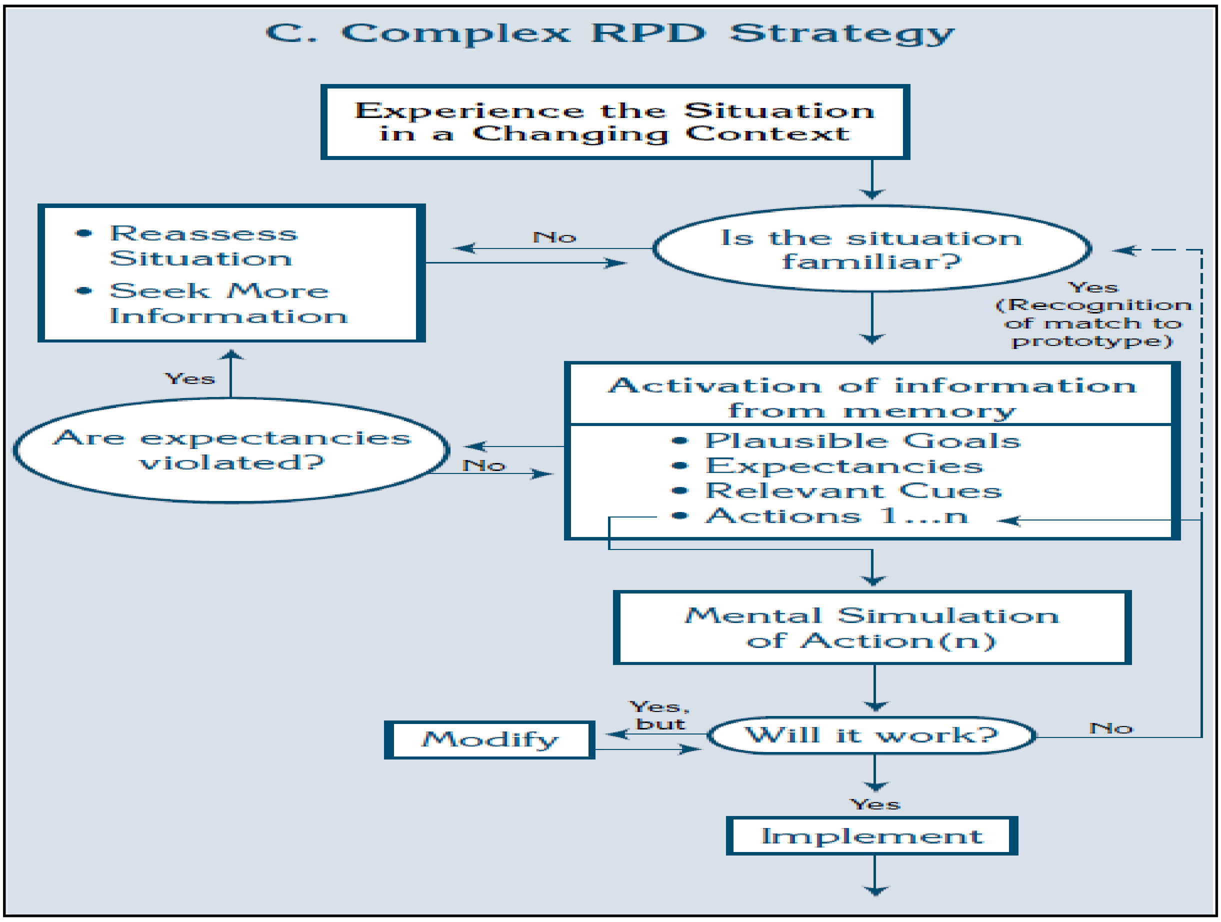

Figure 1. 6 (source: Klein & Klinger, 1991).

Expertise is fundamental in the three possible cycles of action but represents, respectively:

a) a sense of typicality;
b) the base to construct mental models, and
c) an ability to mentally simulate a course of action (Lipshitz, Klein, Orasanu, & Salas, 2001).

Furthermore, according to Klein & Caldenvood, decision-makers are primed, even if the determination is not completely based on the assessment process, by the outcomes of the situational assessment which is defined as *identifying the current state of the world including goals and assumptions* (Klein & Caldenvood, 1991, p. 1018).

Klein & Caldenvood (1991) report four aspects of situation assessment that refer to:

a) understanding goals which could be reasonably accomplished;
b) context-cues salience enhancing;
c) expectations' formation as accuracy control in the assessment, and
d) typical action identification.

To sum up in an operational perspective, according to Klein, *if there is enough time the decision maker will evaluate the dominant response option by imaging it, conducting a mental simulation to see if it will work. If it does, it will be implemented. If it runs into problems, it will be modified. If it can't be fixed, then it will be rejected, and another likely option will be considered. If there is not adequate time, the decision maker is prepared to implement the course of action that experience has generated as the most likely to be successful. Note that this evaluation is context-specific. The evaluation is directed at how a course of action will fare in an actual situation, not at rating the advantages/disadvantages for various dimensions* (Klein, 1989, pp. 142-143).

The RPDM model describes how proficient decision-makers handle situational stressors, evaluate associated risks and uncertainty, and perform adequate decision-making processes under time constriction. Klein claims that the use of recognitional strategies is not a sign of incompetence or irrationality; rather they can adaptively enable the decision-maker to respond effectively, increasing their source of strength (Klein, 1993).

The Recognition/Metacognition Model (R/M)

Indeed, *recognitionally skilled* in identifying familiar situations, Cohen, Freeman, & Wolf (1996), suggest decision-makers are *meta-recognitionally skilled* to account for how they proficiently verify and correct problems in situations that are not recognized as familiar.

Meta-Recognition Skills are a set of supplementary recognition processes, or critical thinking strategies, that are used by the decision-makers to extend their ability to retrieve appropriate responses to a wider number of situations whether they result familiar or not.

With the idea that proficient decision-makers have these meta-recognition skills, Cohen, Freeman, & Wolf (1996) developed the ***Recognition/Metacognition (R/M) Model*** to account for the ability to make use of the experience of decision-makers, from a certain domain to novel situations enabling them to proficiently handle uncertainty.

According to Cohen, Freeman, & Wolf, *structured situation models (i.e., schemas), often in the form of stories about enemy intent, causally organize information about a situation and provide a basis for meta-recognitional processes. Meta-recognitional processes determine* *when it is worthwhile to think more about a problem; identify evidence-conclusion relationships within the story; critique the story for incompleteness, conflict, and unreliability; and attempt to improve it, by collecting or retrieving new information and revising assumptions* (Cohen, Freeman, & Wolf, 1996, p. 2).

The R/M Model include processes that are:

a) oriented to identify evidence and relations between observations and results;
b) oriented to detect conflicts in the arguments, to assess their completeness, and reliability;
c) implied in the eventual correction of identified problems by additional information improvement, attention shifting or the revision of assumptions;
d) involved in ***quick test*** procedure. These are higher-level processes in which the acceptability of the costs of an eventual delay, the novelty or the uncertainty of the situation, and the costs of errors associated with the chosen action are considered and evaluated (Cohen, Freeman, & Wolf, 1996).

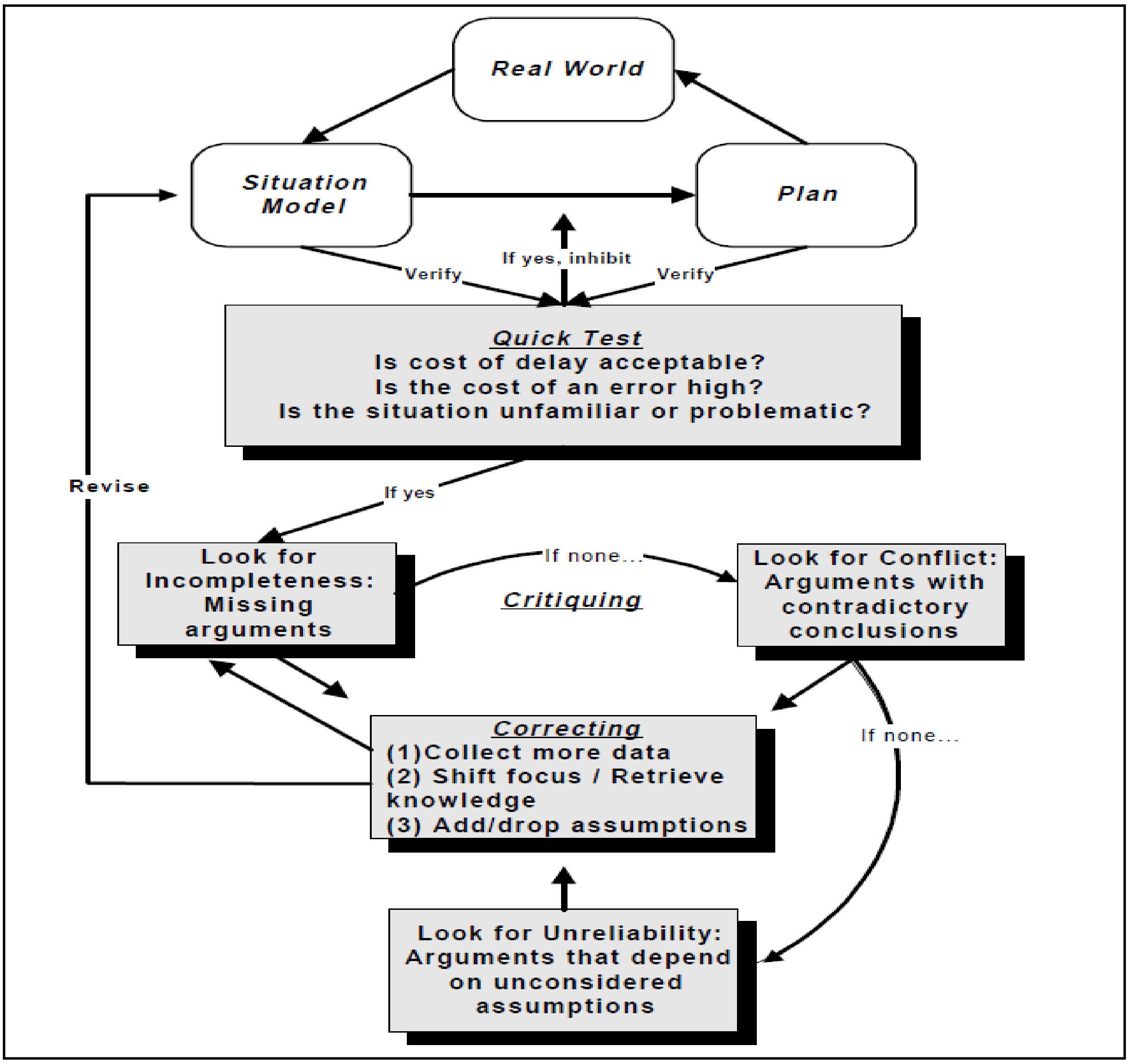

Figure 1. 7 The Recognition/Metacognition (R/M) Model (source: Cohen, Freeman, & Wolf, 1996).

Effective Decision-Making and Uncertainty: The RAWFS Heuristic

Whereas concepts such as risk and ambiguity were investigated in the DM domain, many authors pointed out that *uncertainty constitutes a major obstacle to effective decision-making* (Lipshitz & Strauss, 1997, p. 149).

Even if the concept of uncertainty is central to theories of decision the definition is not so clear and unique.

Lipshitz & Strauss (1997) report that, whereas only few studies address the question about how decision-makers conceptualize uncertainty and the difference with the concept of risk, in literature many definitions for both are available (see Lipshitz & Strauss, 1997, p. 150, for a list of conceptualizations of Uncertainty).

After a review of the literature on DM between 1960 and 1990, Lipshitz & Strauss conclude that, whereas it is convenient to conceptualize, *uncertainty inclusively as a sense of doubt that blocks or delays action in that it relates uncertainty directly to action and encompasses all these conceptualizations, it replaces one unspecified concept by another doubt* (Lipshitz & Strauss, 1997, p. 151).

Moreover, Lipshitz & Strauss suggest specifying the sense of *doubt that blocks or delays actions by their main characteristics that are*:

a) *subjectiveness* (identical situations may raise diverse doubts in different individuals);
b) *inclusiveness* (general doubts) or
c) *effectiveness*. In terms of their effect on actions (e.g. hesitancy, indecision, irresolution, procrastination) (Lipshitz & Strauss, 1997).

Furthermore, these characteristics relate to situational characteristics, doubts about the alternatives and outcomes.

In addition, what causes uncertainty could be identified in the three main sources of doubts and uncertainty:

a) the lack of complete information;
b) the ability to deal with conflicting meanings without being overwhelmed, or
c) a feeble differentiation of alternatives (Lipshitz, Klein, Orasanu, & Salas, 2001; Lipshitz & Strauss, 1997).

Lipshitz & Strauss (1997) report five strategies to cope with uncertainty that are based on:

a) its suppression or ignoring it;
b) its reduction;
c) its anticipation or prevention (forestalling);
d) the use of assumption-based reasoning to derive information, or
e) the *pros* and *cons* weights evaluation and comparison.

According to the ***R****educing,* ***A****ssumption-based reasoning,* ***W****eighing,* ***F****orestalling,* ***S****uppressing* (RAWFS) heuristic proposed by Lipshitz & Strauss (1997), decision-makers cope with uncertainty beginning *by trying to reduce uncertainty by collecting additional information,* [using] *assumption to fill gaps in understanding if that is not feasible,* [comparing] *the merits of competing alternatives if more than one is available,* [retaining] *a back-up alternative to guard against undeliverable contingencies, and* [resorting] *to suppression only as a last resort* (Lipshitz, Klein, Orasanu, & Salas, 2001, p. 338).

With the RAWFS heuristic, Lipshitz & Strauss propose a Naturalistic Decision-Making

alternative to the ***Reduce-Quantify-Plug*** (RQP[2]) heuristic, the standard procedure for coping with uncertainty proposed by Behavioural Decision Theorists, which, in their view, accounts only for less than half of the instances of coping they reported (Lipshitz and Strauss, 1997).
According to Lipshitz & Strauss (1997) the RAWFS heuristic hypothesis is compatible with the Naturalistic Decision-Making framework and links several models proposed in this domain. Moreover, the RAWFS heuristic hypothesis is consistent with the decision-makers' way of conceptualizing and coping with uncertainty in naturalistic setting (Lipshitz and Strauss, 1997).
Concluding, Naturalistic Decision-making Models assume that people have a level of competence that is acceptable and appropriate in a particular situation and have adequate resources that enable them to handle situations without necessarily carrying out detailed and rigorous analysis. Mistakes are accepted for flexibility increase and reactivity (Klein & Caldenvood, 1991).

[2] For more details see Janis & Mann, (1977).

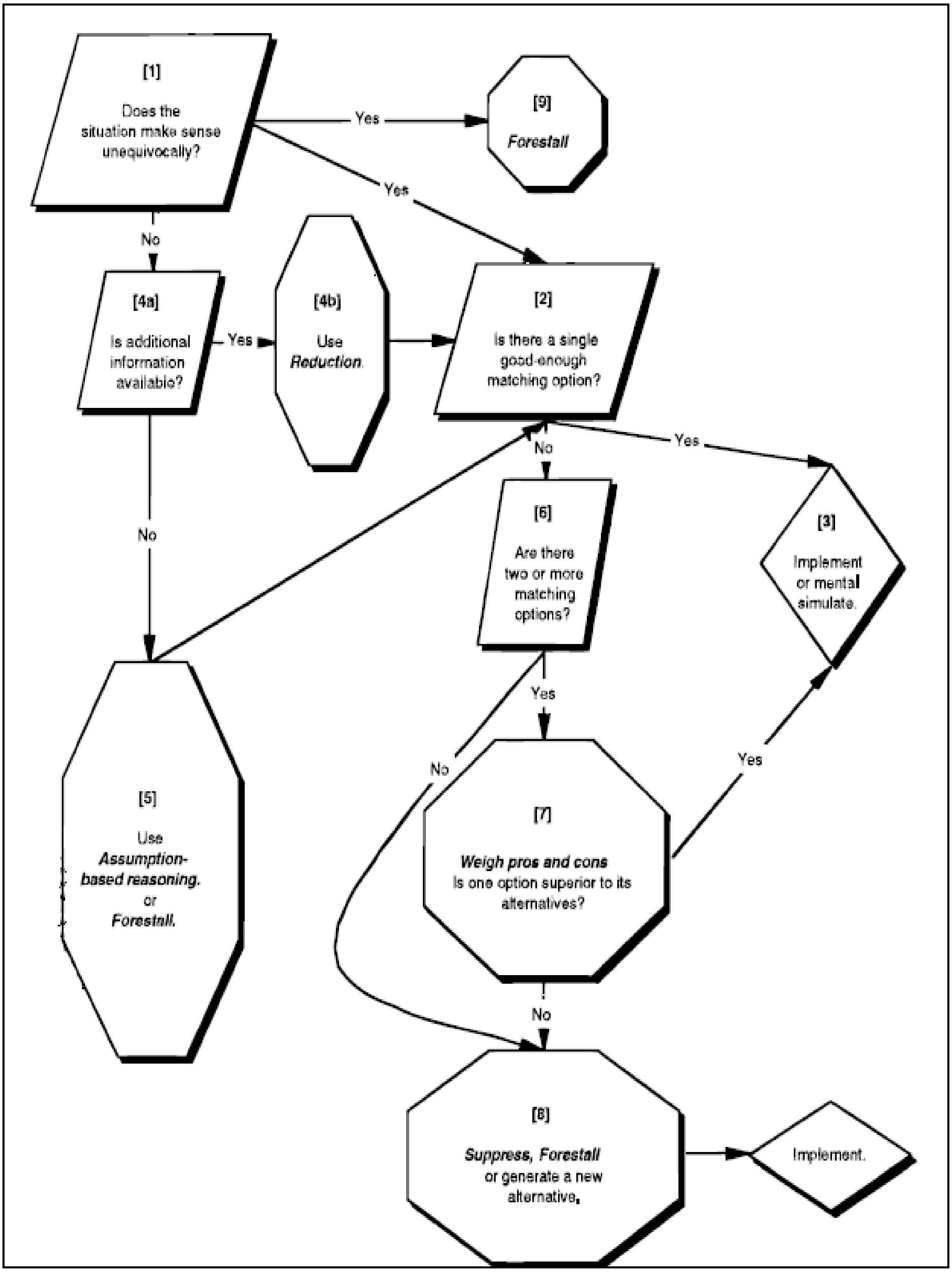

Figure 1. 8 The RAWFS Heuristic (source: Lipshitz & Strauss, 1997).

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Chapter II

Affect System, Decision-Making and Performance

Another dimension along which decision-makers vary is how they experience emotions.
Emotions affect decisions just as the outcomes of decisions affect emotions.
It is widely accepted that cognitive processes are influenced by the affect system and that the ability to process information is reduced in high stress situations.
Furthermore, emotional states may influence cognitive control's components differentially.
Emotions, as well as other affective factors such as arousal, mood, and stress, can have strong effects, increasing the possibility of biased judgements and affecting performance (Gray, 2001).
Many professions (i.e., the police work) are characterized by different levels of stress and are often performed at high levels of acute tension and pressure.
In order to investigate the effect of practising under mild levels of anxiety, Oudejans (2008), Oudejans & Pijpers, 2010, and Nieuwenhuys & Oudejans (2011) used shoot back with coloured soap cartridges in a shooting task to induce anxiety in participants, and found that their accuracy was significantly reduced when they performed under these conditions.
Furthermore, they found that the speed of the police officers' performance was increased, giving less time to be devoted to accuracy when under anxiety.
Results showed police officers' behaviour became less efficient and more stimulus-driven under anxiety, resulting in a decline of performance.
One explanation could be found in the impairment of attention by anxiety, in particular visual attention that could result in distraction from the primary task execution and the hampering of performance (Oudejans & Pijpers, 2010).
Anxiety is not the only aversive emotional and motivational state resulting from threat that a decision-maker such as a police officer could experience.
Other aversive emotions such as fear and anger often accompany police work and act as an early warning system to aid in his survival.

The Affect System: Emotions

In general, people's emotional world is affected by environmental information that is potentially critical for their survival.
The increase of information challenges their ability to determine whether they are under threat or not.
To timely assess the potential state of threat, evolution provided human beings with a system that is able to efficiently and effectively guarantee their survival-promoting adaptive response to stimuli (Norris, Gollan, Berntson, & Cacioppo, 2010).
This is the reason why ***Evolutionary Threat Hypotheses***, such as (F. Pratto & John, 1991) ***Categorical Negativity Theory***, postulates that the detection of survival threatening stimuli have more adaptive value than others. This mechanism is fundamental for survival and its functioning has evolved giving mammalians the capacity to discriminate hostile from hospitable stimuli and for responding adaptively to these stimuli.

The integrated sets of mechanism that serve these functions can be thought as an affect system that has the primary function to discriminate stimuli enhancing emotional responses, namely emotions (Norris, Gollan, Berntson, & Cacioppo, 2010).

Cacioppo, Gardner, & Berntson (1997) explain that *emotions involve an explicit evaluative categorization of a stimulus into positive and/or negative valence classes and the activation of behavioural dispositions that entail bivalent tendencies toward (e. g., approach, acquisition or consumption, affection) or away (e.g., avoidance escape or rejection, withdrawal, repulsion) from the stimulus* (Cacioppo, Gardner, & Berntson, 1997, p. 28).

Thus, people's judgements and decisions are critically influenced by emotions they experience at the time of the decision-making processes, that could enter into the processes either as predictions about outcomes' emotional consequences (***Expected Emotions***) or emotions experienced contemporary to the decision-making process (***Immediate Emotions***) (Loewenstein & Lerner, 2003).

Traditionally DM theories consider *expected emotions* the only emotions that affect decisions in their tendency to maximize positivity in gains and feelings.

As pointed out by Loewenstein & Lerner, *expected emotions are not experienced per se at the time of decision-making; rather, [...] they are expectations about emotions that will be experienced in the future* (Loewenstein & Lerner, 2003, p. 620).

According to Loewenstein & Lerner (2003), people are more emotionally sensitive to their personal situations and eventual changes in their emotional state rather than in the absolute consequences of their decisions. Moreover, utility estimation is affected by the self-evaluation of competence and intellectual ability that derive from expected outcomes and concrete outcomes, and perform these comparisons by comparing the actual situation with counterfactual scenarios. Furthermore, outcomes are evaluated in a different way from standard decision-making models.

Uncertainty, time delay, and potential consequences of the decision are weighted differently according to a non-linear probability weighting function.

Whereas *expected emotions* have a pivotal role in DM, people seem to *systematically mispredict their own affective reactions to the outcomes of their own decisions* (Loewenstein & Lerner, 2003, p. 621). Therefore, the predictions of future hedonic reactions to the results of people's decisions are often biased.

Another way emotions enter in DM is *via* the experience of feelings at the moment of the decision. *Immediate emotions* could affect the process either directly, if they do not affect expectations or cognitive process, or, on the other hand, may have an indirect effect influencing expected emotions or information processing.

In *immediate emotions* the influences are twofold: ***anticipatory*** and ***incidental***. Whereas *anticipatory influences arise from contemplating the consequences of the decision itself,* incidental influences are not related to the decision itself but could derive from many factors either situational or personal (Loewenstein & Lerner, 2003, p. 632). Moreover, emotions raised in events unrelated to the situation at hand may affect incidentally the DM process even if the decision-maker became aware of potential undesiderable consequences or tried to handle the emotional experience (Loewenstein & Lerner, 2003).

It is worth saying that the intensity of emotions is one of the variables that plays a role.

The Dimensions of Emotions: Arousal and Valence

Emotional responses are conceptualized using arousal, valence, and dominance dimensions, whereas psychological data have consistently indicated that emotional response could be efficiently represented by a two-factor model consisting of arousal and valence as primary dimensions.

In fact, dominance dimension, the measure of the feeling of being in control or to be controlled by the emotion, has been relegated to a secondary factor even if maintaining theoretical importance (Bolls, Lang, & Potter, 2001).

Arousal is a well known concept in cognitive psychology, in neuroscience and social psychology because it is believed to play a role in a variety of processes whether intrapersonal or interpersonal (Cacioppo, Petty, Feinstein, & Jarvis, 1996).

Triplett (1898), more than a century ago, studied the effect of the mere presence of others on the performance speed of a simple motor task and explained that positing arousal was responsible for increasing the likelihood of dominant responses. In fact, arousal is believed to affect the performance facilitating execution of easy tasks while hampering performance of difficult ones.

Moreover, having effects on cognitive and affective processes, arousal is considered an intensifier of ongoing behaviour even when residual, that is to say, produced by an irrelevant event as posited by Zillmann's ***Excitation Transfer Theory*** (1971).

Furthermore, arousal has been explained as a personal state, namely a psychologically aversive state (Festinger, 1957), that could be caused by incoherent cognitions and that could cause biased information-processing or attitude-changing in order to reduce the cognitive dissonance that causes the arousal state.

Another important effect of arousal is on attention, as proposed by Easterbrook (1959). In fact, arousal affects attention narrowing the focus and limiting the amount of information or cues an individual could process.

This effect of arousal is especially important in social categorization because arousal makes social categories more salient (Wilder, 1981), facilitating stereotypic associations in social interactions.

General arousal is an initial sensation of an ambiguous and diffuse perceptible state of physiological energization that drives a cognitive search toward a specific feeling of emotional experience (Schachter & Singer, 1962).

The concepts of ***arousal*** and ***activation***, contrary to Cannon’s concept of *energy mobilization during emotion* were used by Daffy (1957) to describe the degree of excitation.

In fact, Daffy clarifies that for *those unfamiliar with the concept of activation, confusion frequently arises between the degree of internal arousal (referred to by the concept) and the vigour and extent of overt responses. While the degree of internal arousal usually correlates fairly closely with the intensity of overt response, a discrepancy between the two may be introduced by the intervention of inhibitory processes, a phenomenon which has not received the degree of attention to which it is entitled* (Daffy, 1957, p. 266).

The sensation of being physiologically aroused creates an *evaluative need* for discovery and labelling the cause of arousal state changing.

Feeling as if there is a change in one’s level of arousal represents important transitions in the

constitution of the automatic response, but the openings between these nodes underscores the continuous nature of this dimension (Cacioppo, Petty, Feinstein, & Jarvis, 1996, pp. 80-81).
Moreover, it has been proposed that environmental stimuli are automatically and continually evaluated by humans without consciousness (F. Pratto & John, 1991) in a relatively simple manner (Schimmack & Oishi, 2005). In fact, stimuli are merely evaluated and categorized by their valence as positive or negative in order to assess their survival value and to determine whether they are hostile or hospitable.
These *responses to environmentally relevant objects and events* (Norris, Gollan, Berntson, & Cacioppo, 2010), namely the emotions, were historically considered to lie on a bipolar continuum linking pleasure to displeasure.
While arousal represents *the level of activation associated with the emotional response and ranges from very excited or energized ... to very calm or sleepy* (Bolls, Lang, & Potter, 2001, p. 629), the valence of an emotional experience is the variation in strength of positive or negative evaluative activation (Cacioppo, Gardner, & Berntson, 1997).

Models to represent emotions

Russell's Circumplex Model of Affect (1980)

Russell's Circumplex Model of Affect *posits that emotions fall in a circular order around the perimeter of the space defined by a bipolar valence dimension and an orthogonal dimension labelled activation* (Larsen, McGraw, & Cacioppo, 2001, p. 684).

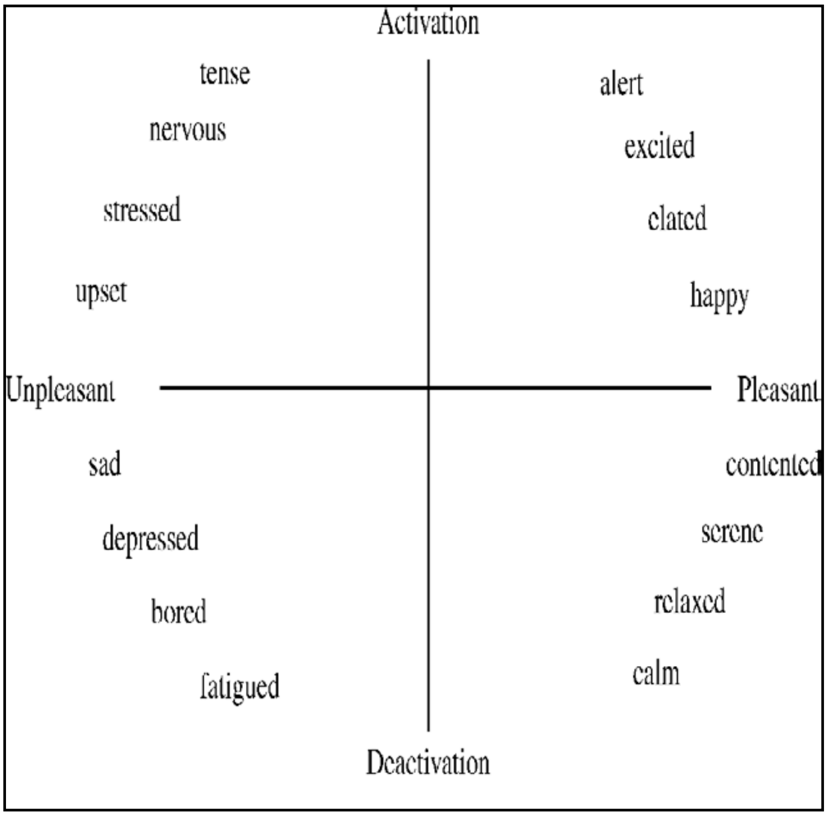

Figure 2. 1 Russell's Circumplex Model of Affect (source: Russell, 1980).

Some emotion like anger, which is an approach-oriented negative emotion (Carver & Harmon-Jones, 2009), however, violates the assumption that negativity leads to motivation to avoid and could not be fully explained with a bipolar model of affect such as Russell's Circumplex Model (Norris, Gollan, Berntson, & Cacioppo, 2010).

The Theory of Motivational Priming

In his ***Theory of Motivational Priming***, P.J. Lang (1995), continuing to conceive emotions along a bipolar valence dimension, propose the existence of two opponent motivational systems:

a) the *appetitive*; and

b) the *aversive* system.

Emotions are primitively associated with either an approach (attachment and consummatory set of behaviours) or avoidance (escape and defence set of behaviours and disposition of the organism).

In fact, emotions, as conceptualized by P.J. Lang (1995), seem to be the manifestation of the priming of associations, representations and actions that are consistent with the activated system (Norris, Gollan, Berntson, & Cacioppo, 2010).

The use of a bipolar conceptualization of emotions, positive and negative valent processes represented on a single continuum that ranges from very positive to very negative and where feeling *less bad* means feeling *more good,* according to Cacioppo & Berntson (1994), is justified by assuming that the three following principles are not violated:

1. ***The principle of joint activation***: an affective response is a joint function of the positive and negative valent functions activated by a given stimulus;
2. ***The principle of antagonistic effects***: positive and negative valent functions generally have opposing effects on an affective response;
3. ***The principle of reciprocal activation***: positive and negative valent functions are reciprocally controlled.

The Somatovisceral Afference Model of Emotion (SAME)

Cacioppo, Petty, Feinstein, & Jarvis (1996) proposed a general flexible framework, the ***Somatovisceral Afference Model of Emotion*** (SAME), within which how emotional experience is influenced by somatovisceral afference could be viewed. The SAME depicts possible mechanisms that could explain how the same discrete emotional experience could be reached by different patterns of somatovisceral afference and how different emotional experiences could be reached by the same pattern of somatovisceral afference.

First of all, before somatovisceral activity undergoes a change as a response to stimulus, it has to be rudimentarily evaluated.

Somatovisceral changes can range from emotion-specific patterns of activation to undifferentiated activation. The cognitive evaluation of somatovisciral afference and emotional significance of the stimulus lead to the recognition of a pattern or to a much more complex attributional analysis and hypothesis testing. The more complex and extensive the cognitive operations are, the longer it takes for the somatovisceral afference to affect emotional experience (Cacioppo, Marshall-Goodell, Tassinary, & Petty, 1992).

The SAME as described in figure 2.2 (p. 38) shows how an emotion could be experienced *via* three very different psycho physiological mechanisms and how the same somatovisceral afference can lead to emotional experience *via* two distinct psycho physiological mechanisms:

a) somatovisceral illusions: Ambiguous afference and primed emotion schema; and
b) cognitive labelling: Undifferentiated afference perception with evaluative need.

The Evaluative Space Model (ESM)

Cacioppo & Berntson (1994), with their ***Evaluative Space Model*** (ESM), proposed that separable operating systems are responsible for processing positivity and negativity, that they together constitute the affect system, and that their ultimate output are behavioural predispositions (attitudes and emotions). Moreover, the ESM assumes that while positivity is linked with appetitive motivation, negativity is linked with aversive motivation.

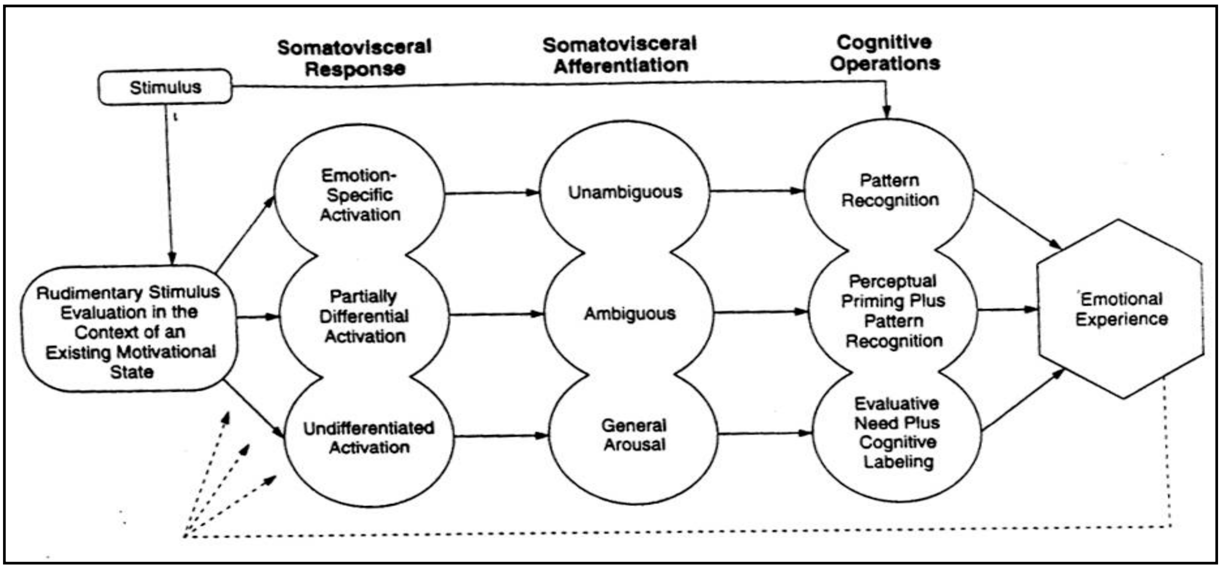

Figure 2. 2 The Somatovisceral Afference Model of Emotion (SAME) (source: Cacioppo, Petty, Feinstein, & Jarvis, 1996).

To capture the functional dimensions of the affect systems, the ESM postulates that (Norris, Gollan, Berntson, & Cacioppo, 2010):

a) Positive and negative affects are not equivalent in their constitution, operations, or consequences. Moreover, positive emotions are more similar to each other than negative emotions are (respectively: *Functional Separability and Level of Organization Postulate*);
b) Positivity and negativity are two distinct dimensions of emotions generally in opposition but not necessarily reciprocally activated. Their combined output cause a behavioural predisposition to either approach or avoid the stimulus (respectively: *Antagonistic Effects and Evaluative Activation Postulate*);
c) Although the most common mode of activation of positivity and negativity is reciprocal activation, and may result in more stable behaviour over time (Energetic Efficiency Postulate), positivity and negativity can be activated independently or co-activated (*Modes of Evaluative Activation Postulate*).

Moreover:

d) Responses to positive or negative stimuli are different in their one-unit increase or decrease because the affective system could have evolved to produce more rapid and stronger responses to aversive and potentially harmful stimuli than to positivity (***Negative Bias***);

e) Positive attitudes toward the environment are fundamental in order to reach a deeper knowledge and to obtain resources useful for surviving. On the contrary, the affective systems could have evolved in a way that in the absence of stimuli in a neutral environment, positive stimuli have stronger effects, resulting in approaching and exploring behaviour (***Positivity Offset***).

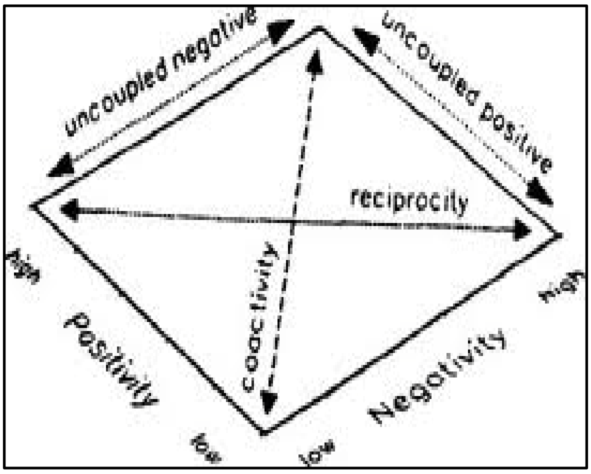

Figure 2. 1 The Evaluative Space Model (ESM). (source: Norris, Gollan, Berntson, & Cacioppo, 2010).

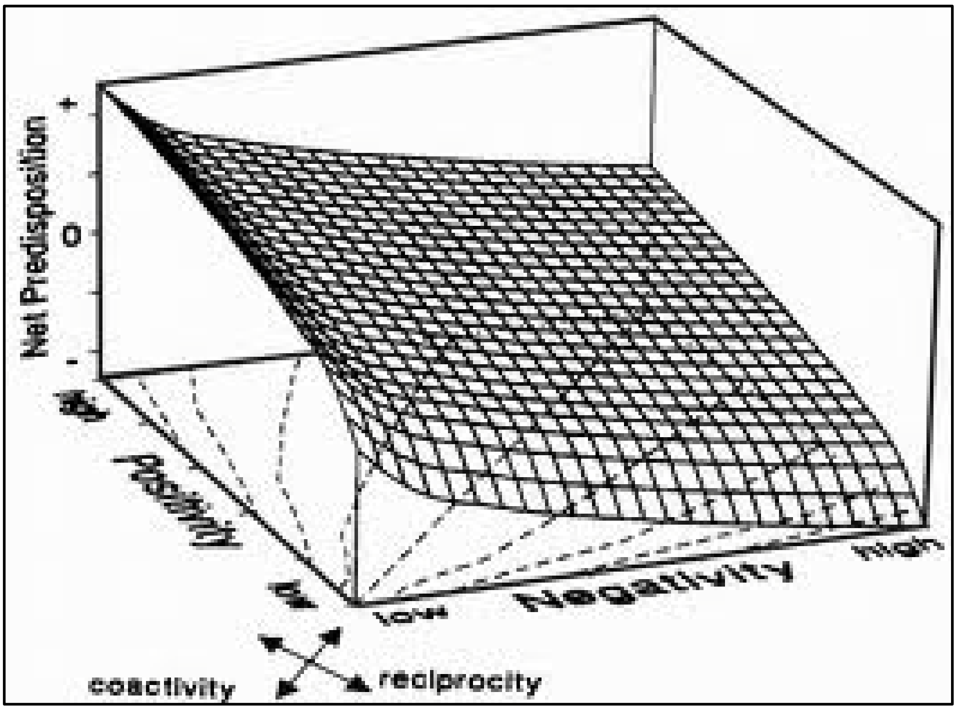

Figure 2. 2 Negative bias and positivity offset in the Evaluative Space Model (ESM) (source: Norris, Gollan, Berntson, & Cacioppo, 2010).

In conclusion, the *evaluative processes represent the integration of two separable and partially distinct components of the evaluative system. Whereas positivity is attuned to appetition and fosters approach, negativity is attuned to threat and fosters avoidance* (Larsen, Norris, McGraw, & Cacioppo, 2008, p. 2).
While the Circumplex Model postulate positivity and negativity are positioned at the opposite ends of a bipolar continuum, thus mutually exclusive (Larsen, McGraw, & Cacioppo, 2001; Larsen, Norris, McGraw, & Cacioppo, 2008) *one implication of the ESM is that the same stimulus can evoke ambivalent positive and negative reactions* (Larsen, Norris, McGraw, & Cacioppo, 2008, p. 2), in a way that emotion such as anger could be explained.

Emotions and Naturalistic Decision-Making
Whereas research in the last two decades has shed light on the effect of emotions on cognitive processes such as DM, information processing, preferences and risk attitude, Mosier & Fischer, presenting their review of literature on affect and decision-making, note that *research on naturalistic decision making-has so far been virtually silent on the issue of emotions* (Mosier & Fischer, 2009, p. 99).
The implicit idea that proficient decision-makers are inoculated against the influence of emotions does not take into account that emotions affect the decisions made by experts in a more complex way.
In fact, information processing in dynamic environments may be affected by emotions in many ways. First of all, in the amount or quality of information that is researched.
Research of information could be mood-congruent biased, that is (Mosier & Fischer, 2009):

a) attention to information may be driven by the need of congruence with the affect state at the moment of the decision.
b) research of information, thus, appears limited to patterns of information that are congruent with the affect state integrated with affect-congruent information, and ambiguity is interpreted in an affect-congruent manner.

Thus, the aim of the present research is to investigate how affect states and environmental cues processing influence performance of people, as well as a well trained category of workers, in a task relevant to their activities, such as the ability to detect weapons and armed targets.

PART II

Weapon Identification and Shooting Behaviour

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Introduction

Several categories of workers (i.e., police officers, personal security experts, etc.) with different personal characteristics and training backgrounds usually need to carry a gun or weapon.

Weapon holders are, therefore, aware that one day the decision to pull the trigger may be necessary.

Contrary to common belief, the sudden decision to shoot or not usually happens unexpectedly, and generally routine activities, i.e., traffic stops or security checks, change immediately into a more complex situation.

In fact, police officers are routinely engaged in activities at different levels of risk but the majority of incidents involving police officers' use of firearms occurs while responding to a routine call for service in what are called ***spontaneous incidents*** (Burrows, 2007).

Therefore, in order to decrease the number of potential incidents, law enforcement personnel and security experts are trained in standard operating procedures or instructed in rules of engagement (Rahman, 2007) and do also receive specific teaching on the legal responsibility and legal consequences of the use of firearms.

Fortunately, not all the weapon holders have experienced the physiological and psychological arousal associated with a real life shooting incident but they do perform, as part of their training, tactical shooting training on the firing range or with virtual weapons training systems.

As part of police officers' training, they perform tactical exercises, including different scenarios, in order to be ready to properly respond when using their weapons or use less than lethal weapons (Burrows, 2007).

Nevertheless, as noted by Nieuwenhuys & Oudejans (2011), regular police training focuses predominantly on the technical, tactical, and physical aspects of performance and mostly neglects the role of psychological factors such as stress, anxiety and emotions.

Decisions such as those to shoot and take a life are called ***split second decisions*** since mostly they have to be taken very quickly (a few milliseconds), despite the tremendous implications they might have on the lives of people involved.

The improper use of lethal force, especially by police officers, has received wide coverage in the media in the past decade and raised concerns by the public because it involves innocent people being killed.

As a result, many researchers started investigating this phenomenon, especially in the USA, where much of the research has been extensively conducted (Barton, Vrij, & Bull, 1998).

Debate has focused on personal qualities in the use of lethal force and the factors that might affect the processes involved in the decision to shoot.

The decision to shoot (or not to shoot) depends on a subjective process that is influenced by many variables, by the perception of characteristics inherent to the decision task itself, and the decision environment (Beach, Mitchell, Deaton, & Prothero, 1978).

The shooting task is complex, involving extensive training, and is familiar to the decision-maker, but in real life most of the time it has to be carried out in ambiguity and is subject to the instability of information and environment, due to the fact that routine activities change

suddenly into a more complex situation where a chain of decisions should be taken rapidly.
Some decisions are reversible while others, such as the decision to shoot, are irreversible and have a high level of significance because they could have tremendous implications on the life of the decision-maker, as well as those who are the target of the decision itself.
Moreover, the real life decision to shoot has a high level of accountability and is carried out under time pressure and constraints.
Researchers tried to explain DM in shooting by investigating personal variables such as race, gender, education and experience, and personality characteristics such as attitude, and perceptions with controversial results.
For example, the suggestion given by several authors that Black officers are more prepared to shoot (i.e., Blumberg, 1985, 1986; Doerner, 1991) is explained by Fyfe (1981, 1982, 1988) as being due more to a disparity in officers' deployment and areas of residence than implicit racial characteristics. Actually, in contrast with common belief (Blumberg, 1985, 1986; Fyfe, 1981, 1982, 1988), Ho (1993) and Doerner (1991) found that race and gender of police officers were not correlated to shooting behaviour.
In addition, Grennan (1987) found that females respond in the same way as male officers do in similar situations, contrary to the common assumption that females are slower to use lethal force (Bell, 1982; Block & Anderson, 1974).
Like personal and personality variables other individual and situational determinants that are believed to affect the decision to shoot were investigated by Vrij & Winkel (1991) who found that temperature affects negatively the impression the police officers form of the suspect, increasing the probability to perceive the behaviour as aggressive.
Moreover, other studies Bell (1982), Block & Anderson (1974); and Vrij (1994) found that street noise resulted in attention narrowing, increasing distraction and reaction time, and forgetting to take cover or react properly.
Apart from the effect of the temperature, Barton, Vrij, & Bull (1998) found that physical effort affects police officers' shooting behaviour and their perception of the suspect, and seems to make police officers feel less aggressive toward the suspect and evaluate the suspect as being less aggressive, resulting in underestimation of aggressive intentions.
Other researchers, such as Correll, Park, Judd, & Wittenbrink (2002) and Correll et al. (2007), focused on the influence of race of the target using a First Person Shooting Task which involved the detection of hostile targets, providing robust evidence of a ***racial bias*** both in the psychological criterion participants adopted in deciding to shoot or not to shoot, and in the speed with which participants made the decisions.
Similar results, using a variety of paradigms, were obtained by different studies (Greenwald, Oakes, & Hoffman, 2003; Payne, 2001; Plant, Peruche, & Butz, 2005).
Payne (2001) suggests that weapon misidentification may hinge on the distinction between controlled processing and automatic accessibility of the stereotype while Correll et al. (2007) argue that targets are quickly categorized according to race, and the relative stereotypes including the concept of danger are promptly activated.
In actual fact, fatal incidents are difficult to explain only with the ***Weapon Bias*** (Payne, Shimizu, & Jacoby, 2005) or the ***Shooter Bias*** (Correll, Park, Judd, & Wittenbrink, 2002; Correll et al., 2007; Payne, Burkley, & Stokes, 2008) hypotheses, and the study of other situational factors should be taken into account.

According to the ***Ecological Contamination Hypothesis*** (Werthman & Piliavin, 1967), which suggests that in a dangerous context people seem more dangerous and probably this will increase the tendency to shoot in general, Correll, Wittenbrink, Park, Judd, & Goyle (2011) manipulated racial and non-racial environmental danger cues showing that it is danger, not race, which is the concomitant cause of the predisposition to shoot.

As mentioned, research on factors related to the police use of deadly force has considered decision-maker characteristics, characteristics of the situation or circumstances of the armed confrontation and the organization and community level factors.

Nevertheless, to my knowledge, only limited research have been conducted concerning the effect of emotions on the decision to shoot (see Nieuwenhuys and Oudejans, 2011; Oudejans and Pijpers, 2009, for studies on the relation between anxiety and training or shooting behaviour).

Emotion such as fear includes many components, for instance changes in the psychological state, cognitive processing, and subjective distress (Barlow, 2001, 2002).

Since the nature of police work often involves DM in the midst of a threatening situation and the extent to which an officer perceives the situation as being a threatening influence on his or her shooting decision, and threatening situational encounters endemic to police work elicit negative emotions such as fear and anger (Pole et al., 2001) that are associated with heightened psychological arousal, the aim of this research is to test whether the components of the emotions are sufficient to alter the performance in a Weapon Identification Task (WIT) (Payne, 2001) as well as in a First Person Shooting Task (FPST) (Correll, Park, Judd, & Wittenbrink, 2002).

The primary dimensions of emotional experience are commonly conceptualized with two dimensions of affective valence and arousal (Cacioppo, Petty, Losch, & Kim, 1986; Dimberg, 1990; Hietanen, Surakka, & Linnankoski, 1998; Jancke, Vogt, Musial, Lutz, & Kalveram, 1996; A. Lang, Newhagen, & Reeves, 1996; P.J. Lang, 1995; P.J. Lang, Greenwald, Bradley, & Hamm, 1993; Newhagen & Reeves, 1992; Wexler, Warrenburg, Schwartz, & Janer, 1992) and, as suggested by Bols et al. (2001), the human emotional experience can be mapped onto a two-dimensional space with valence and arousal as its axes.

One of the aims of this research is to investigate whether arousal is sufficient to alter the perception in general, and specifically of either dangerous objects (i.e., weapons) or threats (i.e., armed target). Thus, arousal was tested firstly in isolation because there is ample evidence to suggest that arousal could influence perception.

Zillman (1971) argued that arousal cues, which usually accompany a fear response, are generally non-specific and are easily transferred from one arousing source to another.

In addition, the emotional arousal associated with highly arousing emotions, such as fear and excitement, has been found to modulate attention and memory (Adolphs & Damasio, 2001; McGaugh, 2004; Phelps, Ling, & Carrasco, 2006).

These findings suggest that emotional arousal can be non-specific and, as a result, may influence perception as well as attention and memory (Adolphs & Damasio, 2001; McGaugh, 2004; Phelps, Ling, & Carrasco, 2006; Stefanucci & Storbeck, 2009).

My hypothesis is that, if arousal is present when decision-makers have to judge if a weapon is present in a categorization task such as the Payne WIT (Payne, 2001), they may attribute the arousal to the object whether they are primed with a White or a Black, and detect more

weapons than really there are.
As well as in the Payne WIT (Payne, 2001), in a FPST (Correll, Park, Judd, & Wittenbrink, 2002), according to the arousal-as-importance approach (Storbeck & Clore, 2008), a feeling of arousal can serve to intensify evaluation of the situation reducing the racial bias.
Recent studies suggest that heightened negative affect usurps cognitive resources that facilitate controlled decision-making (Kleider & Parrott, 2009).
Attempts to regulate negative emotions impair performance suggesting that heightened negative affect and arousal act as a load on cognitive resources and impair performance on capacity-demanding tasks such as DM.
In this study, the affective valence, another component of emotions such as fear, was tested because there is evidence (Schimmack & Oishi, 2005) to suggest that, even if elicited with emotional pictures, they could produce interference in a primary cognitive task.
The valence effect (Positive *vs* Negative affect) was tested in isolation as well as in combination with arousal to investigate if perception and attention could be influenced by emotional pictures as well as in a WIT, as in a FPST.
Both physiological responses and activation of cortex vary for different specific contents within the same valence category (Bradley, Codispoti, Cuthbert, & Lang, 2001; Bradley et al., 2003).
According to Bradley, Codispoti, Cuthbert, & P.J Lang (2001) psycho physiological differences exist between categories of a negatively valenced picture.
Moreover, the evolutionary threat hypothesis (F. Pratto & John, 1991) assumes that stimuli which threaten survival have more adaptive value than the detection of other stimuli and that this adaptive pressure have resulted in a specific detection mechanism for stimuli that presented a threat to survival (Schimmack & Oishi, 2005).
In addition, according to Scherer's sequential evaluation check model (2001), there is a series of appraisals that influences the nature of the unfolding emotion process in response to an emotional stimulus.
The appraisal process does not start with an immediate and automatic assessment of valence or threat; rather, the first check determines how relevant the stimulus for the decision-taker is.
In this research threat stimuli were compared to other affective stimuli to investigate if the affective stimuli have an effect on performance in a WIT as well as in a FPST.
In order to investigate the above-mentioned hypotheses, a series of studies was implemented as follows (for details see p. 35):

1. **<u>Pre-test: selection of stimuli</u>**
2. **<u>Study 1 - Weapon Identification Task (Payne, 2001)</u>**
3. **<u>Study 2 - Weapon Identification Task (WIT)</u>**
4. **<u>Study 3 -First Person Shooting Task (FPST)</u>**
5. **<u>Study 4 - First Person Shooting Task (Correll et al. 2002)</u>**

1. **<u>Pre-test: selection of stimuli</u>**
   <u>Description</u>: The aim of the pre-test was to select stimuli to be used as primes (human faces) and targets (objects) in the different computer tasks implemented for the research. *<u>Subjects</u>*: 25. *<u>Place</u>*: Chicago, Illinois (USA).
2. **<u>Study 1 - Weapon Identification Task (Payne, 2001)</u>**
   <u>Description</u>: Aim of this study was to investigate the effect of arousal, valence on measures of perceptive sensitivity (***d'***), response bias (***c***) and reaction times (RTs). To this end, 3 weapon identification tasks were performed manipulating the affective and arousing content of visual stimuli (IAPS pictures). *<u>Subjects</u>*: 51. *<u>Place</u>*: Chicago, Illinois (USA).
   - T1 - WIT (3 Prime and, only for RTs, 4 Type of response or 2 Object)
   - T2 - Positive vs Negative Valence (Neutral Arousal IAPS pictures) + WIT (2 Valence, 3 Prime and, only for RTs, 4 Type of response or 2 Object)
   - T3 - Positive vs Negative Valence (High Arousal IAPS pictures) + WIT (2 Valence, 3 Prime and, only for RTs, 4 Type of response or 2 Object)
3. **<u>Study 2 - Weapon Identification Task (WIT)</u>**
   <u>Description</u>: Aim of this study was to investigate the effect of arousal, valence and content of IAPS pictures on measures of perceptive sensitivity (***d'***), response bias (***c***) and reaction times (RTs). To this end, 3 weapon identification tasks were performed manipulating the affective and arousing content of visual stimuli (IAPS pictures). *<u>Subjects</u>*: 57. *<u>Place</u>*: Chicago, Illinois (USA).
   - T1 - Positive vs Negative Valence - Assault (Neutral Arousal) + WIT (2 Valence, 3 Prime and, only for RTs, 4 Type of response or 2 Object)
   - T2 - Positive vs Negative Valence - Armed Assault (High Arousal) + WIT (2 Valence, 3 and, only for RTs, 4 Type of response or 2 Object)
4. **<u>Study 3 -First Person Shooting Task (FPST)</u>**
   <u>Description</u>: Aim of this research was to examine how arousal, valence and content of IAPS pictures affect performance on a shooting task and to investigate race bias. *<u>Subjects</u>*: 42. *<u>Place</u>*: Padova, Italy.
   - T1 - FPST (3 Race and, only for RTs, 4 Type of response or 2 Object)
   - T2 - High *vs* Neutral Arousal (Positive Valence IAPS pictures) + FPST (2 Arousal, 3 Race and, only for RTs, 4 Type of response or 2 Object)
   - T3 - Negative Generic *vs* Violence *vs* Armed Assault (Negative Valence High Arousal IAPS pictures) + FPST (3 IAPS pictures Type, 3 Race and, only for RTs, 4 Type of response or 2 Object)
5. **<u>Study 4 - First Person Shooting Task (Correll et al. 2002)</u>**
   <u>Description</u>: As Study 3. *<u>Subjects</u>*: 52 police officers. *<u>Place</u>*: Rome, Italy.
   - T1 - FPST (3 Race and, only for RTs, 4 Type of response or 2 Object)
   - T2 - High vs Neutral Arousal (Positive Valence IAPS pictures) + FPST (2 Arousal, 3 Race and, only for RTs, 4 Type of response or 2 Object)
   - T3 - Negative Generic vs Violence vs Armed Assault (Negative Valence High Arousal IAPS pictures) + FPST (3 Type, 3 Race and, only for RTs, 4 Type of response or 2 Object)

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Chapter III

The Weapon Identification Task (WIT)

In February 1999, four White New York police officers shot [mistakenly] *and killed Amidou Diallo, an unarmed Black immigrant from West Africa* (Payne, 2001, p. 181), and from that date, since it sparked accusations of *racial profiling* and violation of human rights against law enforcement agencies, much research tried to shed light on cognitive processes implied in split-second decisions such as the decision to shoot.

In a series of studies, Payne (2001, 2006), Payne, Lambert, & Jacoby (2002), and Payne, Shimizu, & Jacoby (2005) investigated the influence of racial cues on visual identification of weapons using an *evaluative priming task* (the above mentioned WIT) and analysing data adopting Jacoby's ***Process Dissociation Model*** (1991). The main purpose of Payne (2001) was to disentangle the processes, either automatic or controlled, involved in objects identification when stereotypes are activated and result in response bias.

Payne (2001) developed a priming paradigm in order to investigate if reaction times and accuracy were biased by racial primes, based on the following assumptions[3]:

a) Social judgements are influenced by automatic and controlled cognition;
b) Automatic processes start unconsciously, are intentionally unstoppable, very quick, efficient and need little cognitive resources;
c) Controlled processes, conversely, are conscious, controllable, and intentional;
d) Time pressure increases errors. 500 ms seem to be the Stimulus Onset Asynchrony length after which conscious strategies could replace, or correct, automatic cognition in driving responses.

So far, the Payne WIT (2002) was built as follows:

Prime and target stimuli were digitized photographs 5.3 x 4 cm in size. Prime photos included four Black and four White faces, including two male and two female faces of each race. Target photos included four handguns with varying features, and four hand tools (e.g., wrench, and pliers). On each trial the prime face was presented for 200 ms in the centre of the screen. It was replaced immediately by the target picture (a gun or a tool), which remained on the screen for 100 ms. Moreover, *the target was followed immediately by the response probe. The probe was a 3.5 x 3.5 cm cross that remained red for 700, 450, or 200 ms* [and] *the effective deadline ranged from 1200 to 700 ms* (Payne, Lambert, & Jacoby, 2002, p. 388).

With the experiments of their research, Payne (2001) and Payne, Lambert, & Jacoby (2002) gave a strong support for a ***Weapon Bias Hypothesis*** that accounts for influence of perceptual identification of weapons by race cues. Whereas Black primes cause race-specific errors in time-constraining tasks (harmless objects were more likely to be classified as guns), Black primes facilitate guns' identification in unlimited time conditions. In fact, errors increase linearly as processing time decreases validating the assumption that control over responses decreases with time depletion (Payne, Lambert, & Jacoby, 2002).

[3] For details on the Payne Task see Payne (2001, 2002, 2006)

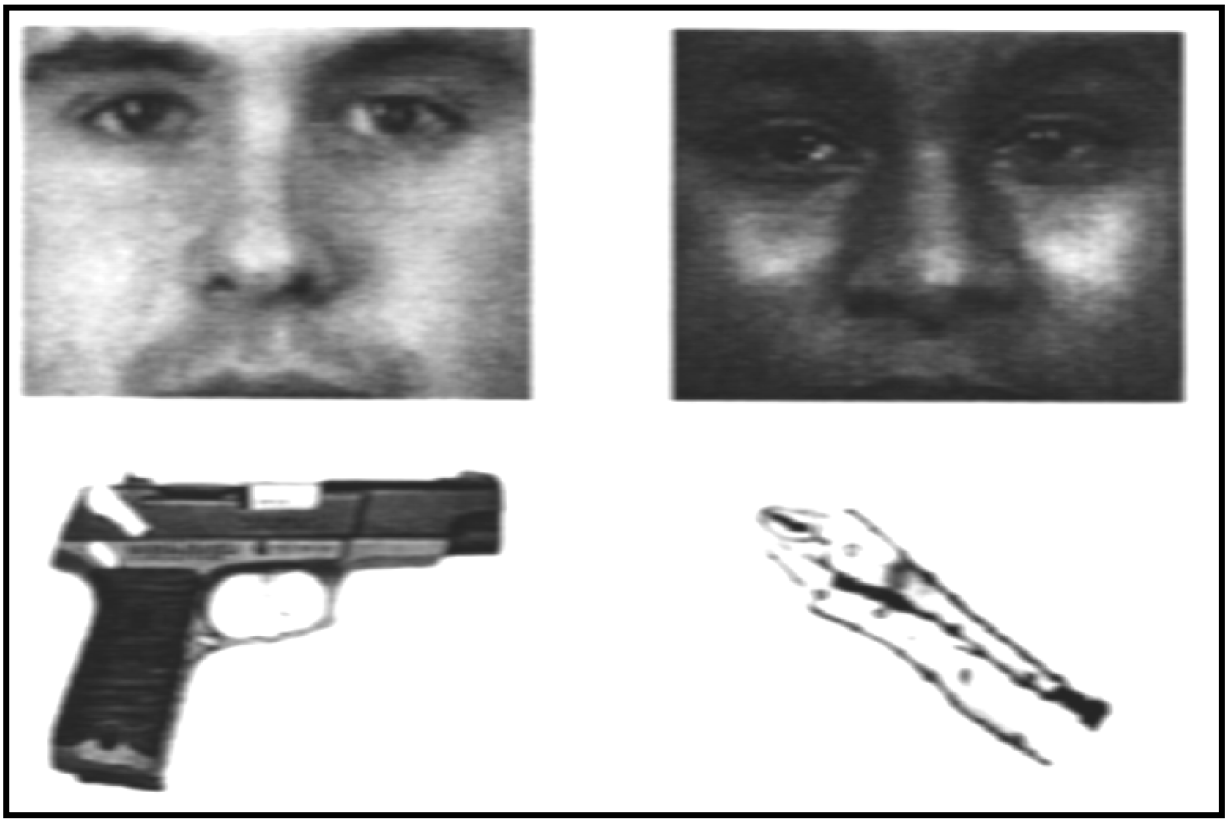

Figure 3. 1 Sample stimuli from Payne (source: Payne, 2001).

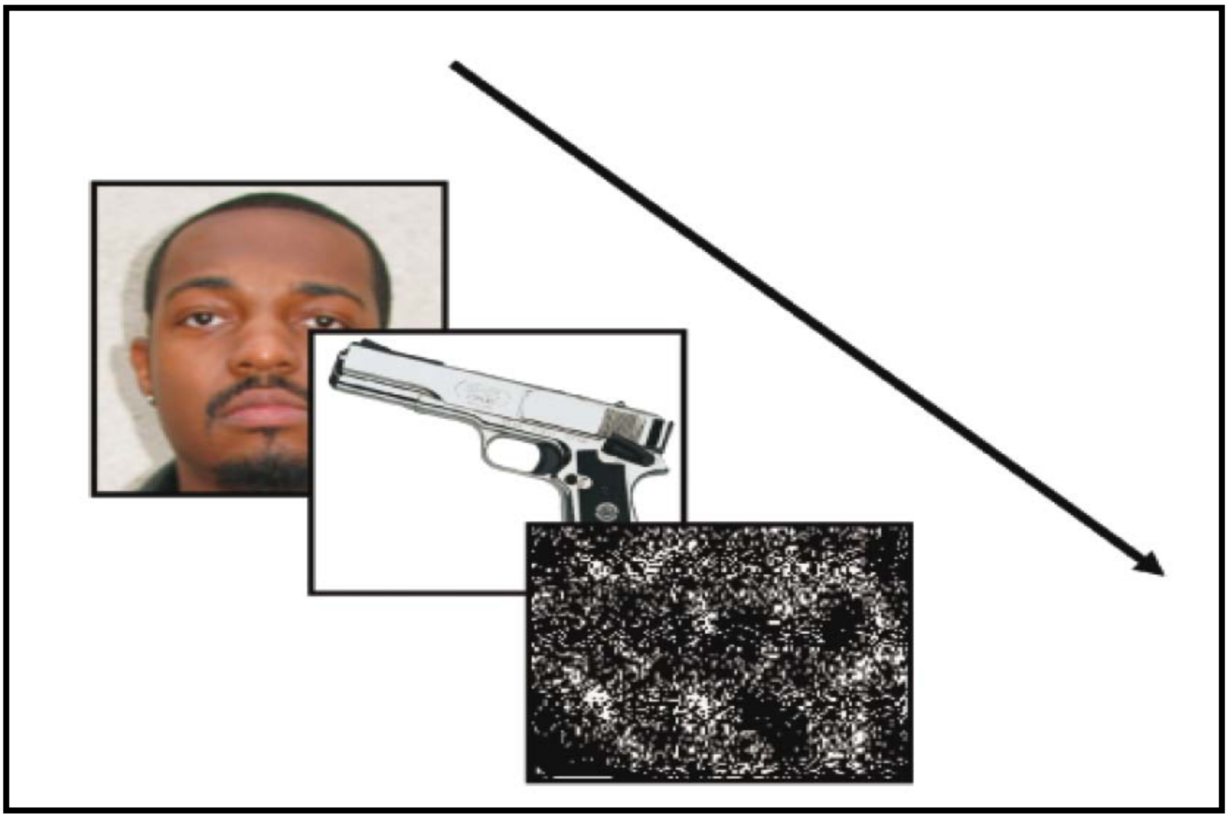

Figure 3.2 Payne's Weapon Identification Task. The schematic illustration of weapon-priming procedure (source: Payne, 2006).

Payne results *strongly support the hypothesis that the race of face paired with objects does influence the perceptual identification of weapons* […] *through relatively automatic processes without changing controlled processing* (Payne, 2001, p. 190).
Moreover, Payne (2001) concludes that to bias performance of participants the task must include stereotypic associations and limited opportunity (time) to control responses.

Dual-Process Theory

Payne (2006), to account for the ***weapon bias***, proposed a ***Dual-Process Theory*** which considers a factor that automatically (impulsively) leads to stereotypic responses, namely the stereotypic association that links Afro-Americans to violence and weapons and, furthermore, could be semantically linked to fear or anger (Payne, 2001). Moreover, in the Dual-Process Theory the role of Cognitive Control is pivotal because, when it is impaired, automatic impulses overcome intentional responses.

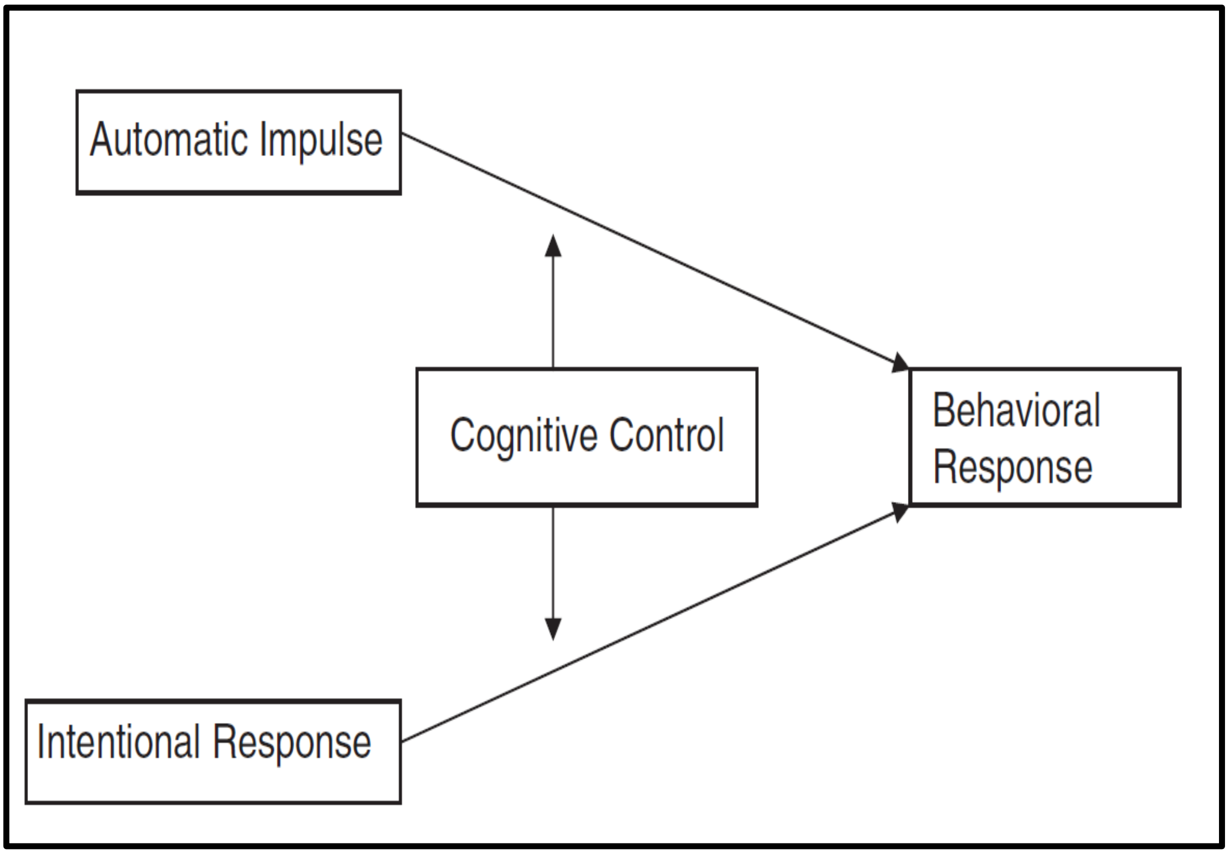

Figure 3.3 Dual-process model of *weapon bias* in Payne (source: Payne, 2006).

Interestingly, Bishara & Payne (2009) tested five multinomial models that are commonly used to account for the relationship between controlled and automatic processes[4], concluding that the Process Dissociation Model (PDM) (Jacoby, 1991) provides an accurate description of the processes implied in the ***weapon bias***.
Besides PDM there are other computational procedures to account for bias response and

[4] See Bishara and Payne (2009) for more details.

discrimination ability. Greenwald, Oakes, & Hoffman (2003) assessed the eventual effect of different computational procedures, PDM and Signal Detection Theory (SDT - Green & Swets, 1966) concluding that results of their analysis were not affected by the computational differences. In fact, PDM and SDT measure sensitivity and bias response with two parameters that are analogous, whereas they use *different underlying decision process assumptions* (Greenwald, Oakes, & Hoffman, 2003, p. 404).

Signal Detection Theory (SDT - Green & Swets, 1966)

Detection theory is a general psychophysical approach to measuring performance (Macmillan & Creelman, 2008, p. xvii).

SDT could be applied to the study of performance in categorizing tasks where responses belong to one class of different types of stimuli for measuring sensitivity in discriminating signals.

Conversely the so-called *detection tasks*, where the participant has to discriminate between two classes of stimuli in which one contains only the null stimulus, tasks such as Payne’s WIT (2001) or Correll et al.’s FPST (2002) are called *recognition tasks* because participants are requested to categorize stimuli where neither stimulus is null.

Anyway these two different tasks are analysed in the same way with the aim to evaluate the sensitivity of participants and evaluate if bias is displayed (Macmillan & Creelman, 2008).

In tasks such as Payne’s WIT or Correll et al.'s FPST four types of responses could be given: Hit, Correct Rejections, Miss and False Alarm.

Correct responses are the right detection of a weapon or an armed target (Hit - H) as well as the exact categorization of a tool or an unarmed target (Correct Rejection - CR).

Conversely, errors are the wrong categorization of a weapon as a tool or not to shoot at an armed target (Miss - M) or the wrong classification of tool as a weapon or to shoot at an unarmed target (False Alarm - FA).

Whereas there are many ways to measure sensitivity, the most widely used is called ***d’*** (dee-prime) and it is a function of H and FA rates.

H and FA rates are respectively the proportion of H and the sum of H plus Miss [H/(H+M)] and the proportion of FA and the sum of FA and CR [FA/(FA+CR)].

In calculating ***d’***, H and FA rates are converted to ***z*** scores using the Gaussian ***z*** transformation resulting in the following formula:

$$d' = z(H) - z(F)$$

In experiments where perfect score (i.e., 100 % of Hits) and chance performance are avoided or such data are discharged, ***d’*** values would roughly result in values between 0.5 (Correct responses = 60%) and 2.5 (Correct responses = 90%).

Besides discrimination indexes there are several bias measures that have the purpose of measuring the participants’ willingness to respond *weapon* or to shoot.

A widely used measure of bias is called ***c*** (for *criterion*) and reflects the degree to which either shooting tendency (or weapon responses) dominate or a more conservative attitude is preferred (e.g., tool or do not shoot response is preferred).

The following formula is used to calculate ***c***:

$$c = -\frac{1}{2}\,[z(H) + z(FA)]$$ [5]

Whereas sensitivity measure (***d'***) depends on difference of H and FA rates (e.g., increase with H and decrease with FA), ***c*** depends on their sum.

Thus, while unbiased responding will return a value of ***c*** equal to 0, negative values mean FA rate exceeds Miss rates and, conversely, positive values mean FA rate is lower than Miss rate.

Extreme values of ***c*** are ± 2.33 (e.g. H rate = .99 and FA rate = .99; ***c*** = - 2.33; H rate = .01 and FA rate = .01; ***c*** = + 2.33) and 0 represent the midpoint (e.g. H rate = FA rate) (Macmillan & Creelman, 2008).

To sum up, whereas ***d'*** values would roughly result in values between 0.5 and 2.5 where values increase according to the ability to discriminate ambiguous stimuli (signal and noise), ***c*** values would result in values between ± 2.33 according to the willingness of the participant to respond *weapon* or shoot and the direction toward which the eventual bias is displayed. Thus, whereas *trigger-happy* criterion and weapon response would result in negative values, conservative tendency in responding do not shoot or tool would result in positive values.

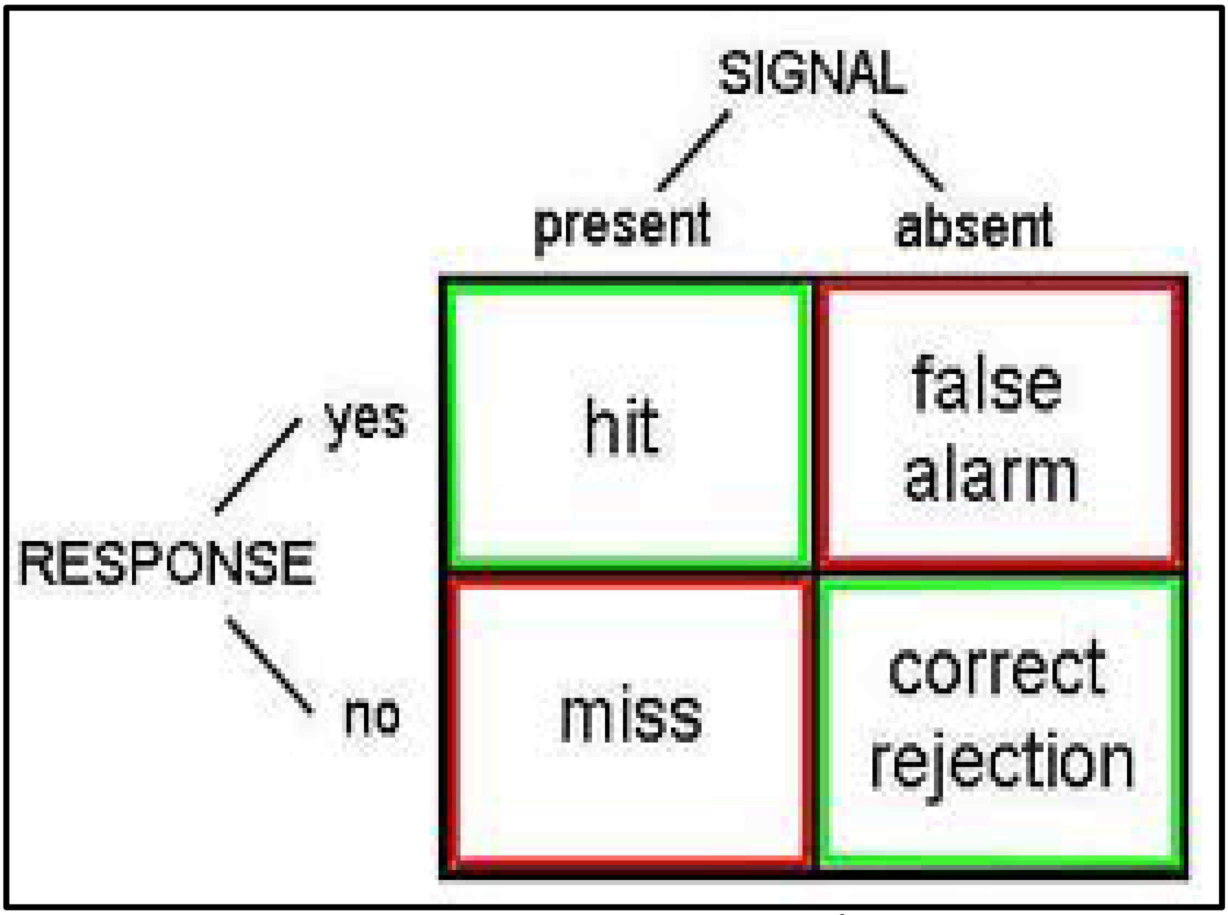

Figure 3.4 SDT response types (Source: Signal Detection Theory Handout[6]).

[5] Macmillan and Creelman, 2008

[6] http://www-psych.stanford.edu/~lera/psych115s/notes/signal/

Pre-Test: Selection of Stimuli

The aim of the pre-test was to select stimuli to be used as primes (human faces) and targets (objects) in the different computer tasks implemented for the research.

Subjects

Twenty-five US-born citizens [13 Afro–AM, 7 F, 6 M; 12 Other (White, Hispanic, Pacific Islanders, Asian), 5 F, 7 M; Age M 25.67; DS 9.92] participated in return for $2.

Material (Primes)

Eighty faces wearing neutral expressions were selected from the database of Florida Department of Corrections (US) (http://www.dc.state.fl.us/) using the Offender Search Options (Sex = Male; Race = Black/White; Age = 20/40; Offense Category = All).

Twenty-five independent raters compiled a form (People) where the eighty pictures (2.5 cm x 3.3 cm) were viewed and categorized, each picture as being part of a minority group with a confidence level on their response (from 1 uncertain to 7 certain) and the probability of being a violent criminal (from 1 no/little to 7 very probable/ certain) (see figure 3.5, p. 43).

As previously mentioned, Payne's (2001) results support the hypothesis that the stereotypic association that links Afro-Americans to violence and weapons could automatically (impulsively) lead to stereotypic responses.

Moreover, Correll et al.'s results are consistent with the hypothesis that stereotypes link Blacks to danger and promote racial bias in the decision to shoot (Correll et al., 2007) and were replicated by Greenwald, Oakes, & Hoffman (2003), Plant & Peruche (2005), and Plant, Peruche, & Butz (2005).

In order to avoid any stereotypic association with violence/danger/weapons/threat and fear/anger, primes' stimuli were selected in order to reduce the probability of being stereotypically perceived as violent criminals.

The violent criminal probability rating was chosen because the concept semantically and generally contains the associations with violence, danger, weapons, and threat. In fact, the American Psychological Association defines **violence** as *an extreme form of aggression, such as assault, rape or murder*[7] that with addition of non-negligent manslaughter and robbery crimes meets the definition of the FBI's Uniform Crime Reporting (UCR) Program.

Moreover, the FBI's UCR Program defines **violent crimes** as *those offenses which involve force or threat of force*[8], and the Sentencing Guidelines Annual Report (1996-97) of the Florida Department of Corrections (USA) defines as violent those crimes which *involve actual or the threat of physical harm to a person or* those that have *a reasonable probability of causing unintended physical harm or physical threat of harm to a person*[9].

The main idea was to exclude stimuli represented by human faces that were strongly (automatically/impulsively) associated with the concepts of violence and crime in order to avoid the activation of stereotypic responses.

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[7] APA; http://www.apa.org/topics/violence/index.aspx

[8] US Department of Justice; http://www2.fbi.gov/ucr/cius2009/offenses/violent_crime/index.html

[9] http://www.dc.state.fl.us/pub/sg_annual/9697/appendices.html

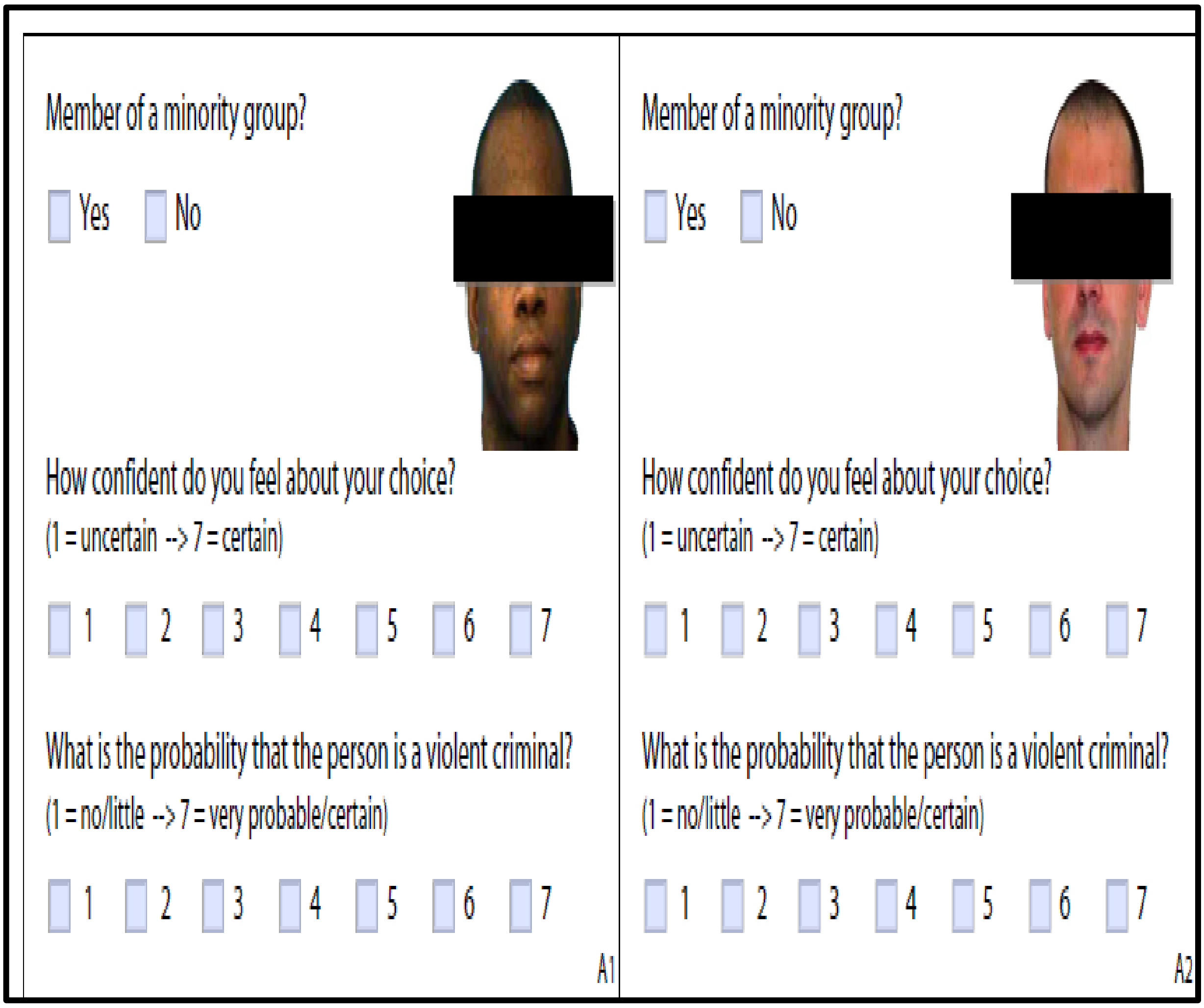


Figure 3.5 Sample of people form utilized for the pre-test.

The reliability (Combarch's alpha) of the rating for the People form was: Confident feeling of choice = .94 and Probability to be a violent criminal = .99.

As result, the following stimuli were selected:

a) 12 pictures of faces classified as Non-Minority Group members by 95.42% of the raters with a level of confidence of 6.51 (SD 0.15) and probability to be a violent criminal of 3.74 (SD 0.48);

b) 12 pictures of faces classified as Minority Group members by 23.82% of the raters with a level of confidence of 5.93 (SD 0.36) and probability to be a violent criminal of 3.46 (SD 0.41);

c) Moreover, a set of 7 Neutral stimuli were obtained with two–tone scrambled face silhouette pictures.

Material (Targets)

The same group of twenty-five independent raters compiled a second form (Objects) and categorized eighty pictures of objects (2.5 cm x 3.3 cm), collected from internet, for being a weapon or a tool with a confidence level on their response (from 1 No Idea to 7 Certain) and the level of its dangerousness (from 1 Harmless to 7 Lethal).

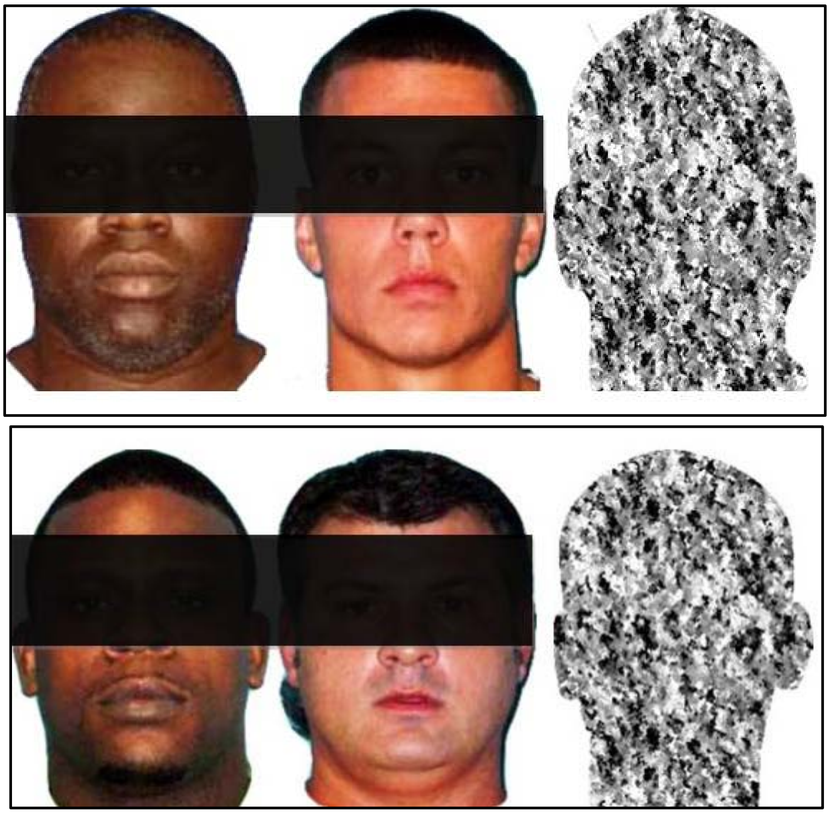
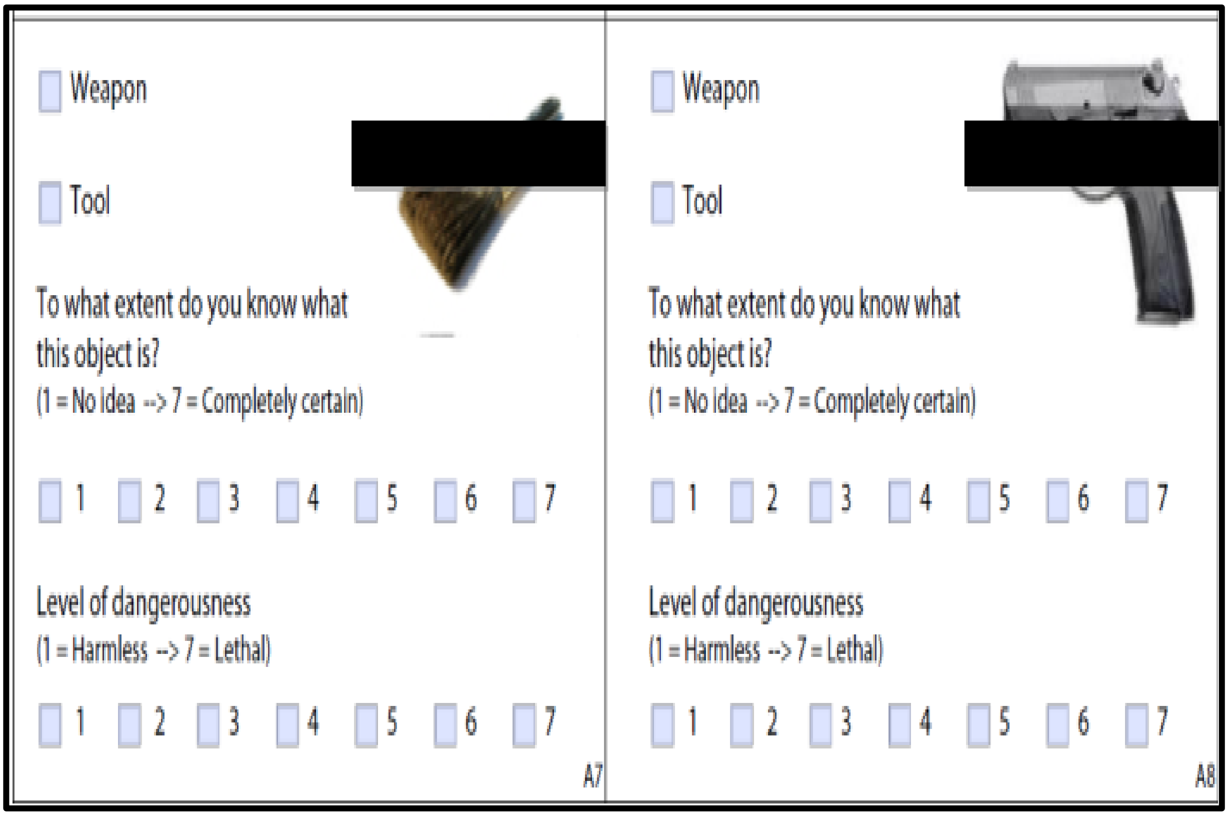


Figure 3.6 Sample of prime stimuli.



Weapon

Tool

To what extent do you know what this object is?
(1 = No idea --> 7 = Completely certain)

1 2 3 4 5 6 7

Level of dangerousness
(1 = Harmless --> 7 = Lethal)

1 2 3 4 5 6 7

A7

Weapon

Tool

To what extent do you know what this object is?
(1 = No idea --> 7 = Completely certain)

1 2 3 4 5 6 7

Level of dangerousness
(1 = Harmless --> 7 = Lethal)

1 2 3 4 5 6 7

A8

Figure 3.7 Sample of object form.

The extent of the familiarity with the object rating was chosen to avoid any ambiguous object. The aim was to obtain two groups of pictures represented by completely harmless objects and totally lethal weapons.

The reliability (Combarch's alpha) of the rating for the Object form was: Extent of knowledge = .94 and Level of dangerousness = .96.

As result, the following stimuli were selected:

a) eight pictures of objects classified as weapon by 98.7% of the raters with a level of confidence of 6.78 (SD 0.26) and level of dangerousness 6.86 (SD 0.15);

b) eight pictures of objects classified as tool by 100% of the raters with a level of confidence of 5.98 (SD 1.13) and level of dangerousness of 2.11 (SD 0.7).

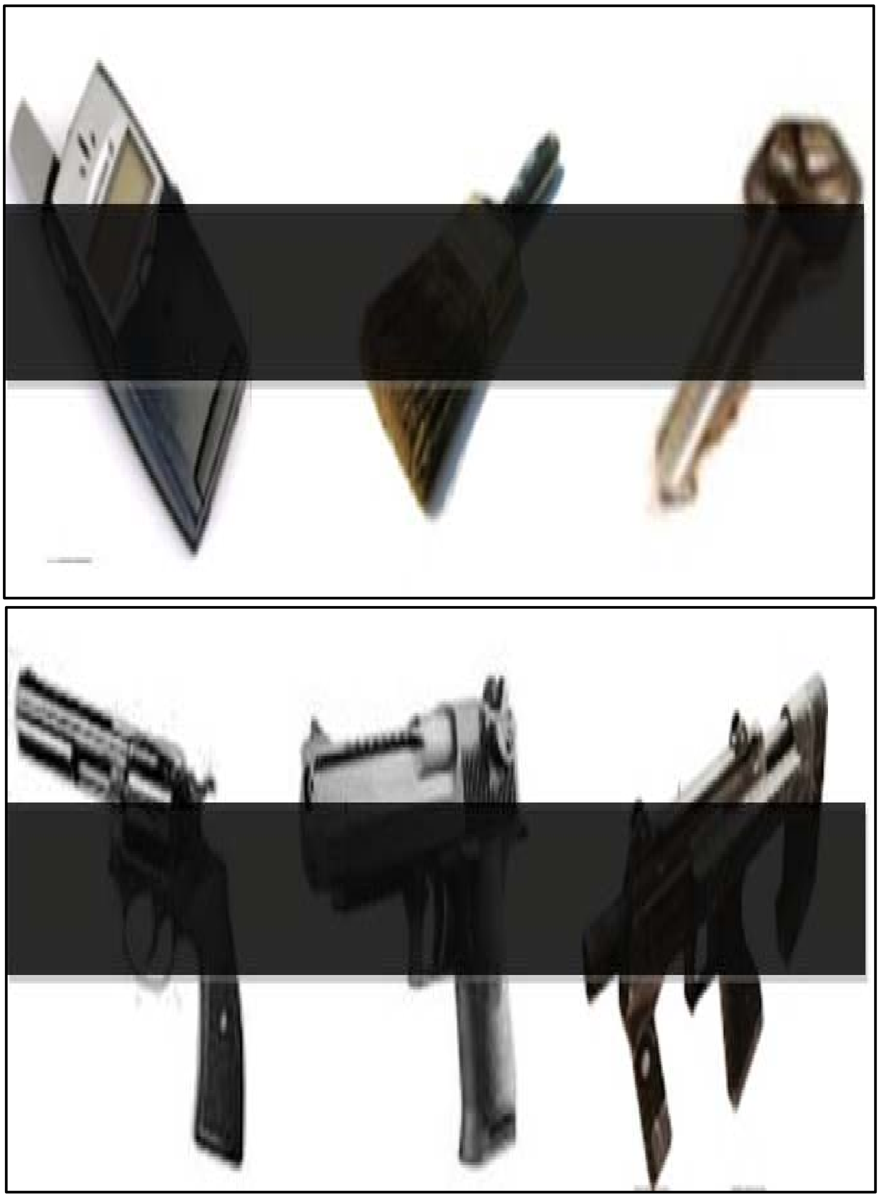


Figure 3.8 Sample of target stimuli.

The Objects and People ratings were completed in blocks, either rating the Objects' pictures before People's pictures or vice versa.

Participants were instructed as follows:

Objects Form

We are now going to present you five papers with a total of 40 pictures (8 per paper) on which you will have to express a judgement. For each picture you will have to check the appropriate answer: If you believe what is portrayed in the picture is a Weapon or a Tool.
Moreover, using a scale ranging from 1 to 7, you have to indicate to what extent you know what is the object (1 = No idea → 7 = Completely certain) and how dangerous it is (1= Harmless → 7 = Lethal).

People Form

We are now going to present you five papers with a total of 40 pictures (8 per paper) on which you will have to express a judgement. For each picture you will have to check the appropriate answer: If you believe the person portrayed in the picture is a member of a minority group (YES/NO).
Moreover, using a scale ranging from 1 to 7, you have to indicate how confident you feel about your choice (1 = uncertain → 7 = certain) and what is the probability that the person portrayed in the picture is a violent criminal (1 = no/little → 7 = very probable/sure).

Study 1

Methods

Participants and design

Fifty-one US citizens (45 born in the USA; 22 Afro-American, 10F, 13M; 20 White-American, 8F, 12M; 7 Other, 4F, 3M; age: M=23, 3; SD=3,1) participated in return for $6.

Stimuli (Prime and Target)

Prime and Target stimuli were digitalized photographs 5.3 x 4 cm in size (Payne, 2001).
Prime stimuli included twelve White and twelve Black faces and target stimuli included eight Weapons and eight Tools.

Stimuli (International Affective Picture System - IAPS; Lang, Bradley, and Cuthbert, 2008)

Four groups of 9 digitalized 20 x 16 cm IAPS pictures were created. Stimuli were selected according to IAPS standard ratings, as reported in Table 3.1, and the groups, homogeneous for Valence and Arousal, named as follows:

a) Group 1 (H_N): Arousal = High and Affective Valence = Negative
b) Group 2 (H_P): Arousal = High and Affective Valence = Positive
c) Group 3 (L_N): Arousal = Low and Affective Valence = Negative
d) Group 4 (L_P): Arousal = Low and Affective Valence = Positive

	G1 H_N		**G2 H_P**		**G3 L_N**		**G4 L_P**	
	1050		5621		1111		1811	
	1120		8030		1275		5600	
	1321		8178		7360		5660	
	1525		8179		9090		5830	
	1931		8180		9320		7200	
	7380		8185		9340		7260	
	8480		8186		9373		7330	
	8485		8370		9470		7350	
	9921		8400		9830		7508	
	Valance	**Arousal**	**Valance**	**Arousal**	**Valalce**	**Arousal**	**Valalce**	**Arousal**
M	3.29	6.54	7.16	6.91	3.10	4.99	7.46	5.05
SD	0.76	0.33	0.46	0.27	0.46	0.15	0.32	0.11

Table 3. 1 Tables of IAPS pictures selected, Means and SD for Valence and Arousal (Study 1)[10].

[10] Lang, P.J., Bradley, M.M., & Cuthbert, B.N. (2008). International affective picture system (IAPS): Affective ratings of pictures and instruction manual. Technical Report A-8. University of Florida, Gainesville, FL.

Procedure

Participants were seated 60 cm from a 15’’ computer screen (resolution 1280X1024, Ref. T. 60 Hertz, Colours 32 bit) and were told that further instructions were available on the screen.

Personal data recording

After a phase when demographic information was requested, participants self-assessed their emotional state and arousal using a nine point scale (1 = extremely happy or pleasurable to 9 = very unhappy or sad; 1 = very excited or aroused to 9 = very calm or sluggish) as in the Self Assessment Manikin (SAM; (Bradley & Lang, 1994; Hodes, Cook III, & Lang, 1985) digitalized on the screen.

Priming task

Training trials

After the completion of the preliminary phase, participants entered a training phase of 60 trials to familiarize themselves with the task.

All participants were warned they were beginning the experimental phase and instructed as follows:

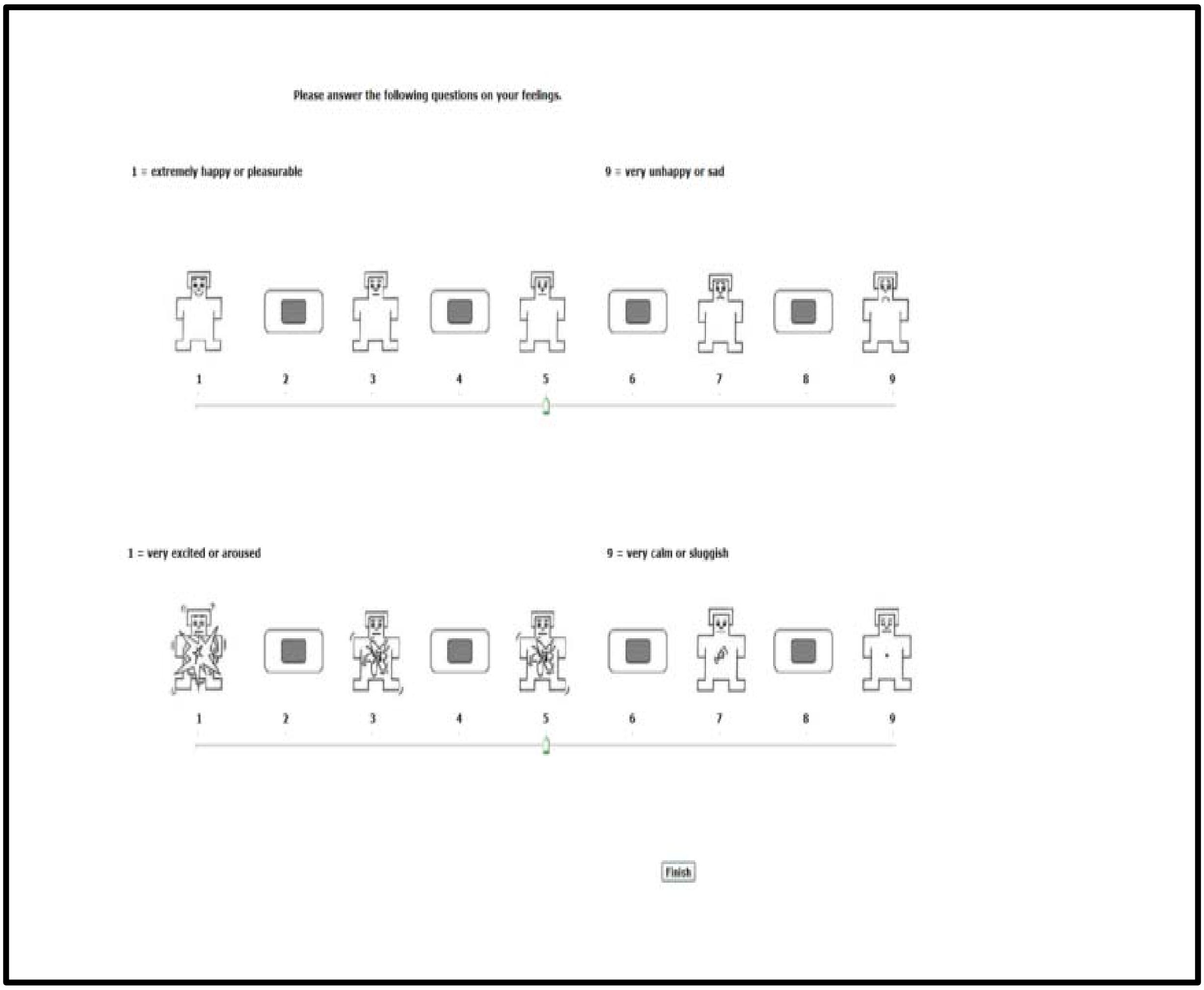


Figure 3.9 Sample of SAM (Bradley & Lang, 1994; Hodes, Cook III, & Lang, 1985) as was digitalized on the screen.

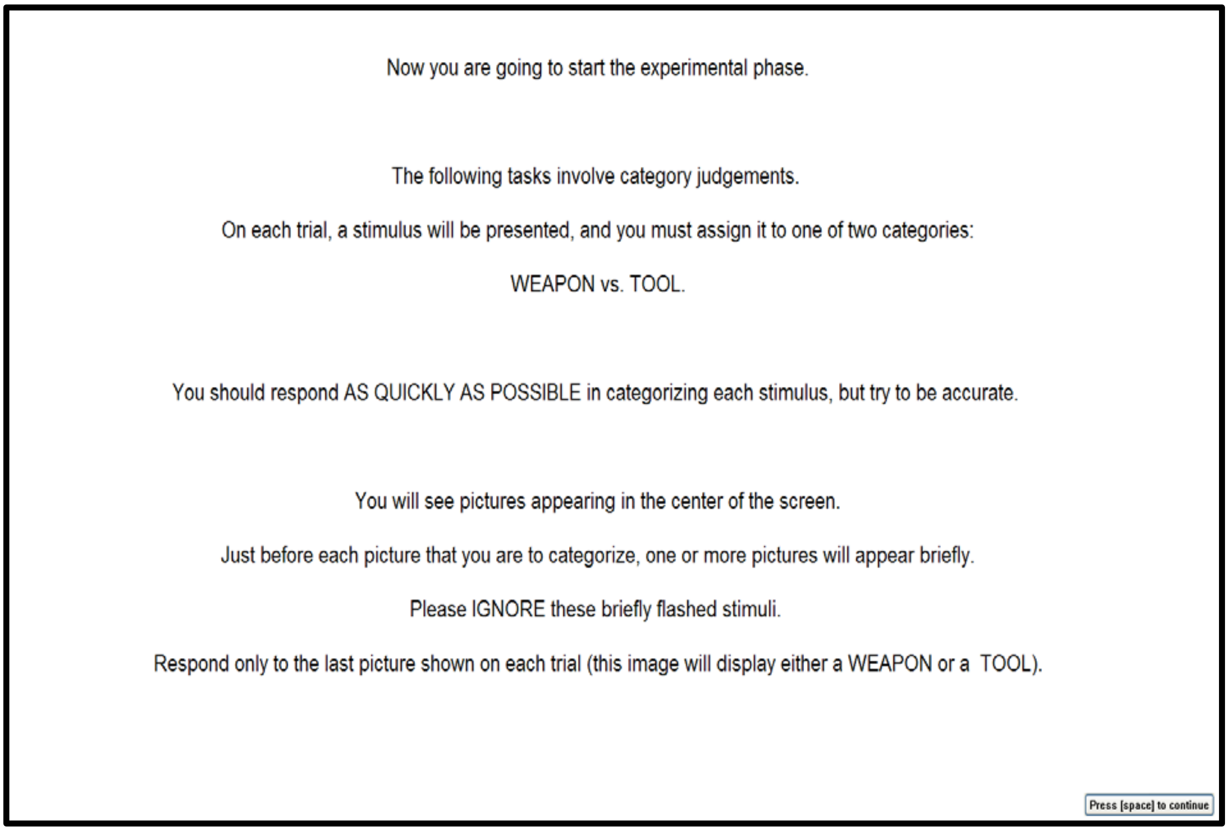


Figure 3.10 Sample of instructions.

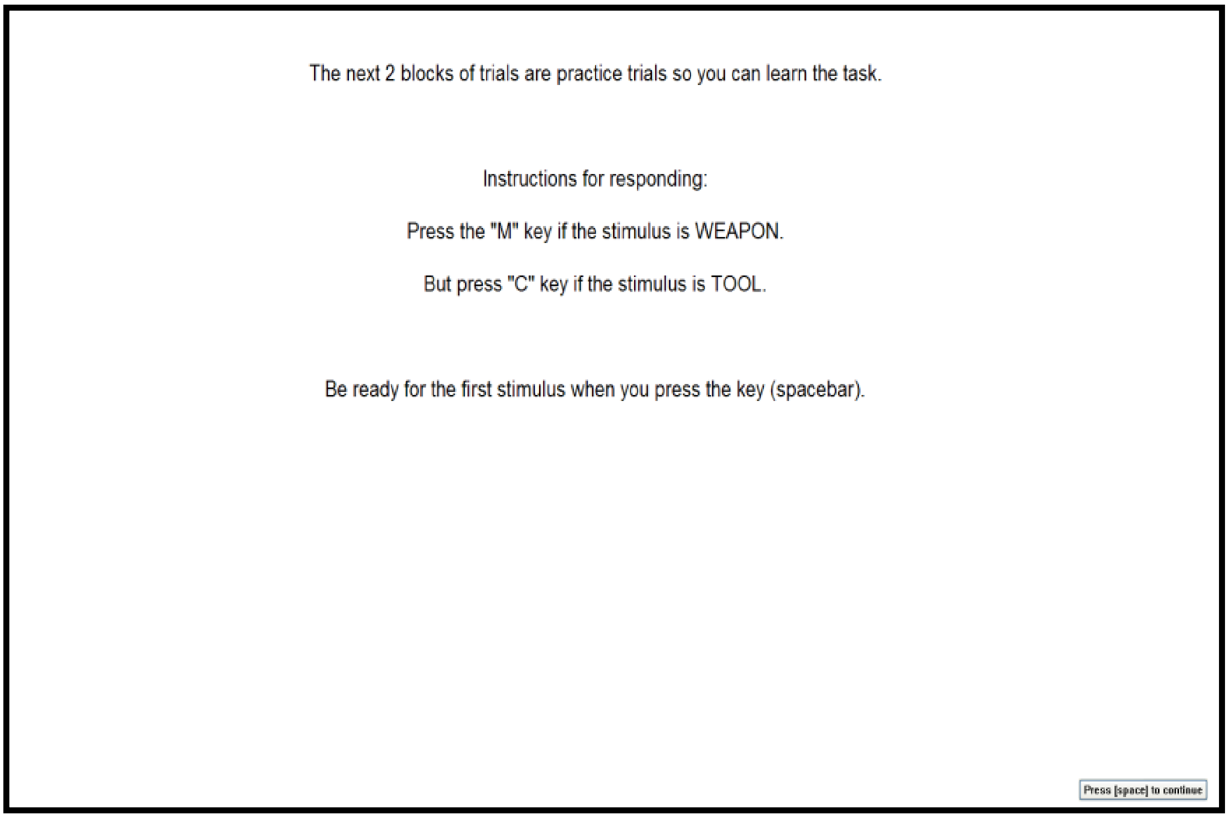


Figure 3.91 Sample of instructions for practice trials.

Participants then started a block of 60 practice trials in which they were presented with a Neutral Prime and after 200 ms this was replaced by the target (weapon/tool).
Participants had to respond pressing a response key (C/M) to categorize the object.
After 100 ms the object was masked and after 500 ms a "faster" sign appeared if any response key were pressed.
Participants received a red "X" as negative feedback or a white "+" as positive feedback that remained on the screen till the next trial was presented thus the effective deadline was 900 ms after the mask was superimposed on the target.
After 700 ms another trial would start.
The training trials were designed to help participants learn the priming task and respond within the deadline.
After the completion of the training phase they had a feedback, reporting data of their performance (Average, fastest and slowest responses in milliseconds and the number of correct responses) and were requested to:
"Please respond AS QUICKLY AS POSSIBLE in categorizing each stimulus, but try to be accurate".
After the report page a warning that they were entering the test trials and reminding them which of the computer keys they had to use to respond were provided by the computer.

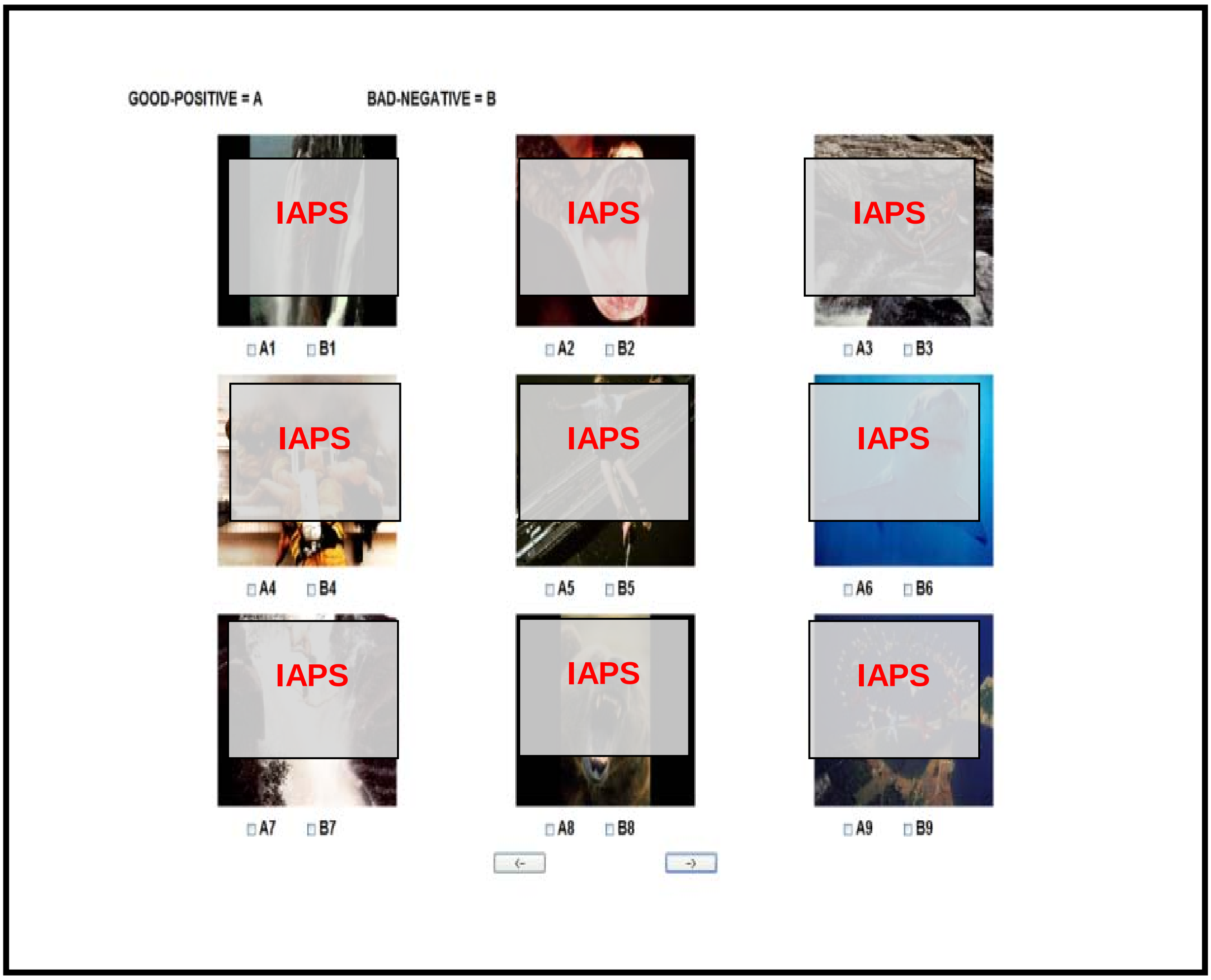


Figure 3.102 Sample of IAPS pictures categorization phase.

Task 1 (132 trials)

Participants were then presented with test trials in which a prime varying in ethnicity (Black/White/Neutral) was used and, as in the practice trials, after 200 ms this was replaced by the target (weapon/tool).

Text trials were similar in sequence to practice trials but varied Intervals of stimulus presentation.

The “faster” sign appeared if any response key were pressed after 300 ms instead of 500 ms and the effective deadline was 700 ms after the mask was superimposed on the target instead of 900 ms.

This timing sequence created a very challenging task, putting a lot of time pressure on participants who were requested to respond to a really high chain of stimuli.

Stimulus categorization phase 1 and 2 (18 each)

Having completed Task 1, participants were requested to categorize eighteen pictures (two rounds of nine each, balanced in their affective valence values and with equal mean of arousal value ratings) according to their representation for the participants (good, positive, or pleasant *vs* bad, negative, or unpleasant) (Fig. 3.12).

After the selection phase the pictures were presented, alternated in their affective valence value (Positive/Negative/Positive/Negative etc.) to participants’ full screen size and participants had the opportunity to watch the pictorial stimuli at their own pace.

Pictures presented in the categorization sub-phase and in the re-view sub-phase were used in the following priming task.

Then participants received a warning informing the participant than he/she was entering a new phase of the experiment and reminding them which computer keys they had to use to respond.

Task 2 and 3 (132 trials each)

IAPS pictorial stimuli were presented for 400 ms before the priming task as in Task 1.

Thus, Task 2 had Low Arousal IAPS pictures presentation before the priming task, either Positive or Negative, and Task 3 had High Arousal IAPS pictures presentation, either Positive or Negative.

Altogether, participants had to perform 456 trials, 60 training trials (using only Neutral human figures); 132 trials for Task 1; 132 trials for Task 2; and 132 trials for Task 3.

Reaction times were recorded in milliseconds and perceptual sensitivity (***d’***) and response bias (***c***), such as ***Signal Detection Theory*** (SDT) claims, were computed using Hit and False Alarms rates to measure the effect of object, race, arousal and valence on participants’ performance.

To control the right-hand effect the response key (C/M) were balanced; thus a group of participants received instructions to press “C” key for Weapon and “M” key for Object and another group *vice versa*.

To control the effect of the exposure to arousing stimuli on the sequence of the priming tasks (Task 2 and Task 3), phases 4 and 5 and phases 7 and 8 were completed in blocks, either completing phases 4 and 5 before phases 7 and 8 or vice versa.

Thus, the computer assigned participants randomly to one of the four groups created in such a way that either they had to complete phases 4 and 5 before phases 7 and 8 or *vice versa* and to

respond “C” key for Weapon and “M” key for Object or *vice versa*.
To summarize the experiment proceeded by the following phases:

1. Personal data recording (demographics and SAM 1)
2. Training trials
3. Priming Task (Task 1)
4. Stimuli categorization (Random: High or Low Arousal)
5. Priming Task (according to preceding phase: Task 2 or 3).
6. SAM (2)
7. Stimuli categorization (according to preceding phase: High or Low Arousal)
8. Priming Task (according to preceding phase: Task 2 or 3)
9. SAM (3)

Analysis found no main effects or interactions involving sex, ethnicity, response key order, or blocks order, thus all the following analyses collapse over these factors. The main dependent variables included Ethnicity (Black, White, and Neutral), the Type of the Target (tool *vs* weapon), Arousal (High *vs* Low), and Valence (Positive *vs* Negative).

Design

The design of the experiment was:

a) For **Task 1**: 3 ETHNICITY (Black, White, and Neutral) x (only for RTs) 4 TYPE OF RESPONSE (Hit, CR, Miss, and FA) or 2 OBJECT (weapon *vs* tool).
b) For **Task 2** (AROUSAL = Low): 2 VALENCE (Positive *vs* Negative) x 3 ETHNICITY (Black, White, and Neutral) x (only for RTs) 4 TYPE OF RESPONSE (Hit, CR, Miss, and FA) or 2 OBJECT (weapon *vs* tool).
c) For **Task 3** (AROUSAL = High): VALENCE (Positive *vs* Negative) x 3 ETHNICITY (Black, White, and Neutral) x (only for RTs) 4 TYPE OF RESPONSE (Hit, CR, Miss, and FA) or 2 OBJECT (weapon *vs* tool).

SDT (Hit rate, FA rate, ***c*** and ***d’***) parameters were computed.

Results

A priori it was decided not to record responses given after the timeout for each trial for the three tasks and to record responses given before the presentation of the target as “0”, recoded then as system-missing value for the analysis. As result a loss of data of 4.5% for Task 1, 3.9% for Task 2, and 2% for Task 3 was recorded.
Moreover, subjects with less than 70% of responses recorded (or system-missing value) and 60% of medium latencies as outliers were discharged. As result, two subjects were discharged by data analysis; thus, final analysis was performed on data recorded for forty-nine subjects.
Analysis of RTs on correct responses solely comported the exclusion of 34% of data for Task 1, 35% for Task 2, and 29% for Task 3.
Latencies were log-transformed then averaged for each condition. Supplemental analyses performed on untransformed data produced very similar results. Thus, results are reported in milliseconds (ms) for reaction times and untransformed for SDT parameters.

[Significance is reported in tables with * for p < .05 and ** for p = < .001]

Task 1 (No IAPS pictures)

Two analyses of variance (ANOVA) were computed for each dependent variable:

1. Ethnicity of the prime (Ethnicity) and Type of response (RType, only for RTs) for all the responses;
2. Ethnicity of the prime (Ethnicity) and Type of object-target (Object, only for RTs) for corrected responses.

The design included, respectively, one or two within-subjects factors:

1. Ethnicity (Black, White, and Neutral) for SDT parameters, and (Hit, CR, Miss, FA) for RTs;
2. Ethnicity (Black, White, and Neutral) for SDT parameters, and Object (weapon and tool) for RTs.

<u>*Reaction Times (RTs)*</u>

Results for control trials (Neutral Prime) show participants' RTs significantly differed in relation to the RType they gave [F (3, 138) = 32.718, p < .001] (see Table 3.2 for Means and S.E., p. 54).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RType on: Hit responses as compared to CR [F (1, 46) = 32.006, p< .001], with a large effect size (r = .64); CR responses as compared to Miss [F (1, 46) = 98.438, p < .001] with a large effect size (r = .82).

No significant effect for Miss as compared to FA was found [F (1, 46) = 2.732, p = n.s.].

As for the analysis performed only for control trials (Neutral Prime), results of the analysis of variance (ANOVA) for the two within-subjects factors Ethnicity (Black, White, and Neutral) and RType (Hit, CR, Miss, FA) show participants' RTs significantly differed in relation to the RType they gave [F (3, 126) = 62.843, p < .001] (see Table 3.3 for Means and S.E., p. 54).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RType on: Hit responses as compared to CR [F (1, 42) = 6.743, p < .001], with a medium effect size (r = .37); CR responses as compared to Miss [F (1, 42) = 126.843, p < .001] with a large effect size (r = .87).

No significant effect for Miss as compared to FA was found [F (1, 42) = 1.572, p = n.s.].

No other significant main effects or interactions were found.

A second repeated measures analysis of variance (ANOVA) was performed on mean RTs for each ethnicity (Ethnicity) – Object type (Object) combination after having dropped RTs (34%) for incorrect responses as in Payne (2001). Results for the two within-subjects factors Ethnicity (Black, White, and Neutral) and Object (weapon and tool) show participants' RTs significantly differed in relation to the Object [F (1, 47) = 70.674, p < .001; r = .77] (see Table 3.4 for Means and S.E., p. 54).

Tables for RTs: Task 1, Study 1 (Means and S.E.)

RTYPE	MEAN (ms)	S.E.
HIT	374** r = .64	13.888
CR	415** r = .82	13.456
MISS	333	13.501
FA	349	12.518

Table 3. 2 RT Means and S.E. for control trials (Task 1).

RTYPE	MEAN (ms)	S.E.
HIT	370** r = .37	13.350
CR	411** r = .87	14.016
MISS	332	12.200
FA	339	11.962

Table 3. 3 RT Means and S.E. for complete data (Task 1).

OBJECT	MEAN (ms)	S.E.
Weapon	379** r = .77	12.670
Tool	422	13.688

Table 3. 4 Object: RT Means and S.E. for correct responses (Hit and CR, Task 1).

Discussion (Study 1 - Task 1)

Whereas participants were affected by the object to be categorized, as in the Payne study (2001), in this study no other main effect or interactions were found either on reaction times or SDT parameters.

Due to the absence of racial effects it could perhaps be evident that:

a) The main idea to exclude stimuli represented by human faces that were strongly (automatically/impulsively) associated with the concept of violence, in order to reduce the probability that primes could be stereotypically perceived as violent criminals, avoided the activation of stereotypic responses.

b) The fact that subjects declared to have had experience in similar tasks and participated in experiments comparable to this one (M = 3 times; SD =1.84) suppressed the racial bias. Thus, results support that exposure to the priming paradigm eliminates the response bias (Plant, Peruche, & Butz, 2005);

Moreover, concerning the main effect of the object, comparing Pearson's correlation coefficient ***r*** for the two results, a larger effect was found in the present study on correct responses [$r = .77$ *vs* $r = .45$; $F(1, 30) = 7.88$, $p < .009$ in Payne, 2001]. Again, an explanation could be found in the stimuli selection criteria adopted in this study.

It is perhaps possible that the exclusion of ambiguous objects and the decision to use as target stimuli two groups of pictures represented by completely harmless objects and totally lethal weapons enhanced the effect of objects in certain types of responses (e.g., Correct Responses).

Results, showed wrong responses were quicker and not affected by the target (i.e., no difference between misperception of weapon and tool), whereas correct responses were slower and affected by the target (i.e., significant difference between weapon and tool).

The same tendency was found either on control trials (Neutral Prime) latencies analysed alone or on complete data.

To sum up, wrong responses were quicker and not affected by the target (i.e., no difference between weapon and tool), whereas correct responses were slower and affected by the target (i.e., significant difference between weapon and tool). Moreover, as in the Payne (2002) study, weapons were detected significantly faster than tools.

It is perhaps evident that some responses, correct versus wrong, resulted from different processes and expectations.

Posner's **Inhibition of Return hypothesis** (IOR, Posner & Cohen, 1984) would explain results, arguing that if weapons orient attention in a certain location and *after attention is removed from such a* [...] *location, there is then delayed responding to stimuli subsequently displayed there* (Klein, 2000, p. 1).

That is, if participants were oriented in detecting weapons, when weapons were not present an inhibitory effect could have caused longer latencies in detecting non-weapon objects.

Although IOR explains latencies in correctly detecting weapons and tools, what IOR does not explain is the difference in effect sizes between the two categories of objects.

If participants' attention has been drawn to threatening stimuli (weapons) to be detected in a certain position before attention was inhibited for other objects in the same position, threatening objects would have had a greater effect than tools. Results show the opposite.

Another interesting hypothesis is that every object has one particular level at which contact is

made first with semantic memory (Jolicoeur, Gluck, & Kosslyn, 1984).
Whereas basic-level categorization is done before other stages of categorization can begin resulting faster, its difference with subordinate-level identification disappears with expertise (Gauthier & Tarr, 1997; Tanaka & Taylor, 1991). This effect is called *entry-level shift* and accounts for the faster categorization of expert and atypical objects that are identified at a subordinate level without first being categorized at the basic level (Mack, Wongb, Gauthier, Tanaka, & Palmeri, 2009).
With their paper's subtitle *As soon as you know it is there, you know what it is*, Grill-Spector & Kanwisher (2005) proposed that *image segmentation (detecting that an object is there) and basic level categorization (knowing what it is) could be intimately linked as a stage of visual processing prior to subordinate-level identification* (Mack, Wongb, Gauthier, Tanaka, & Palmeri, 2009, p. 1967).
As for the IOR hypothesis, Grill-Spector & Kanwisher's (2005) hypothesis does not explain the difference in objects' effect sizes that was found in this study.
Alternatively, I propose the hypothesis that participants tried to enhance their ability to respond, biased by the automatic orientation of their attention toward negative stimuli (Schimmack & Oishi, 2005), and by trying to predict the target, basing their probability judgement on previous tasks and rates of previous outcomes.
In fact, images derive from perception. Specifically, they are anticipatory phases of perception, schemas that the observer isolates from the perceptual cycle for other purposes. The experience of building up an image is an internal aspect of a predisposition to perceive the imagined object (Marucci, 2009).
Moreover, support to the ***Prediction-Confirmation Hypothesis*** that I am proposing, is given by the contrast that revealed that, whereas the effect of the object on Hit responses compared to CR responses was medium, ($r = .37$; for control trials = 64), the effect of the object on CR *vs* Miss responses was very large, ($r = .87$; for control trials = 82), and not significant in Miss *vs* FA comparison.
I propose, basically, that responses were given according to a double-level process:

a) the first level, fast and probability-based evaluation of the likelihood objects could be presented, mostly based on previous experience, and responses were given if believed to be very likely;
b) afterwards, in the second level, if the grade of confidence in the probability estimation was not satisfactory, the need to achieve information by looking at the object made participants wait for it. The automatic process that automatically oriented participants' attention toward negative stimuli detection (Schimmack & Oishi, 2005) made weapons and the relative iconic mental representation of weapon-like objects available for a confrontation. Although matching responses were faster, miss-matching responses were slower.

Moreover, when the prediction was considered more likely because of the evaluation of the probability, the response was faster and based only on probability evaluation (chance).
In order to have confirmation it was necessary to wait. Confirmation consisted of the matching between iconic mental representation of weapon-like objects and the target; if the iconic mental representation matched the target (weapon-like – weapon) the correct response was given quicker; if the target was miss-matched (weapon-like – other), the correction of

favourite response affected latencies.

Differences in latencies could be explained by ***Object Recognition Theories*** which propose that objects are recognised thanks to a series of increasingly detailed representations (***Marr's Computational Theory*** - Marr, 1982), or by the recognition of *geons*, namely basic shapes or components that build an object (***Biederman's Recognition-By-Components Theory*** - Biederman 1987).

Images are the result of a peculiar, partially non-repeatable, process of mental construction based on the search and use of cues dispersed in long-term memory. The more the objects are familiar, easier is the mental reconstruction of the objects (Marucci, 2009).

Moreover, according to the ***Evolutionary Threat Hypothesis***, decision-makers in this domain, having to detect the weapon-threat, were more focused on weapon identification (***Weapon offset***) and compared targets to weapon-like iconic mental representation to confirm the classification or not.

Concluding, the schema and the hypothesis proposed seem to be an explanation of results found in this task and will be used as a comparative measure of how other variables eventually affect RTs and SDT parameters in the following conditions.

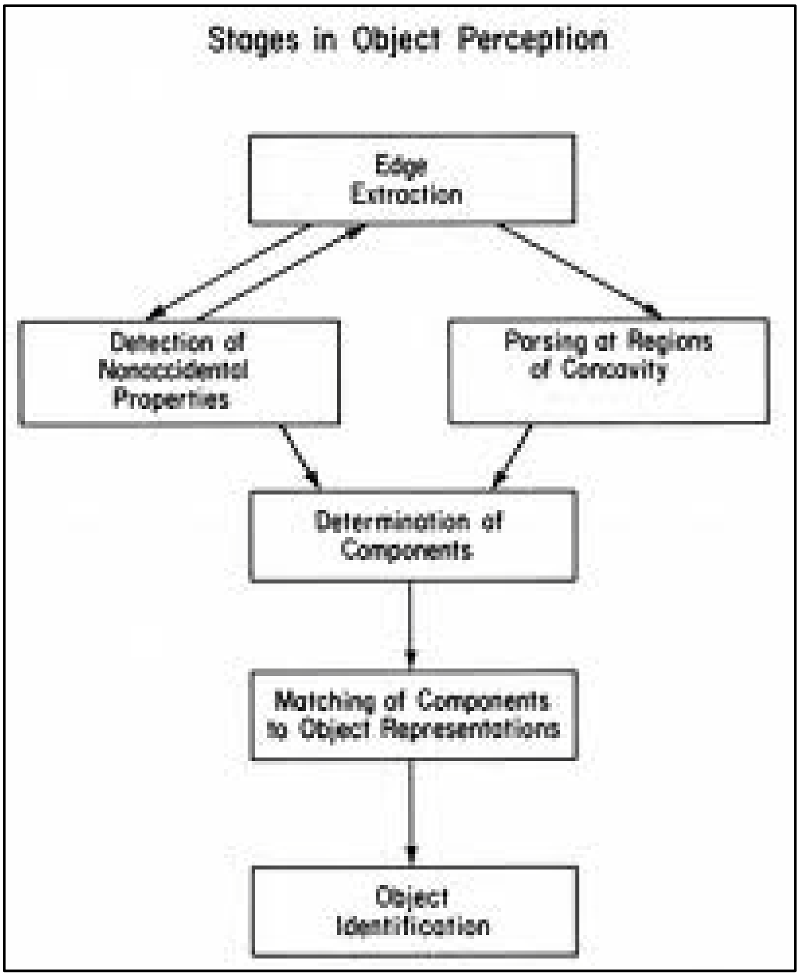


Figure 3. 13 Recognition-by-components: A theory of human image understanding (source: Biederman 1987)[11].

[11]http://psycnet.apa.org/index.cfm?fa=buy.optionToBuyandid=1987-20898-001

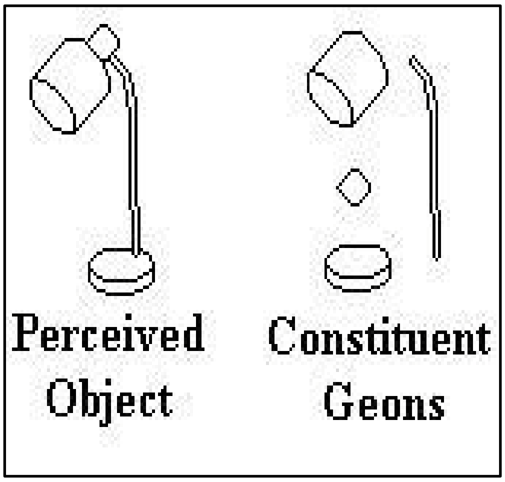


Figure 3. 14 Biederman argues that 36 geons can generate 150 million (source: Sumitava Mukherjee Perception and Object Recognition)[12].

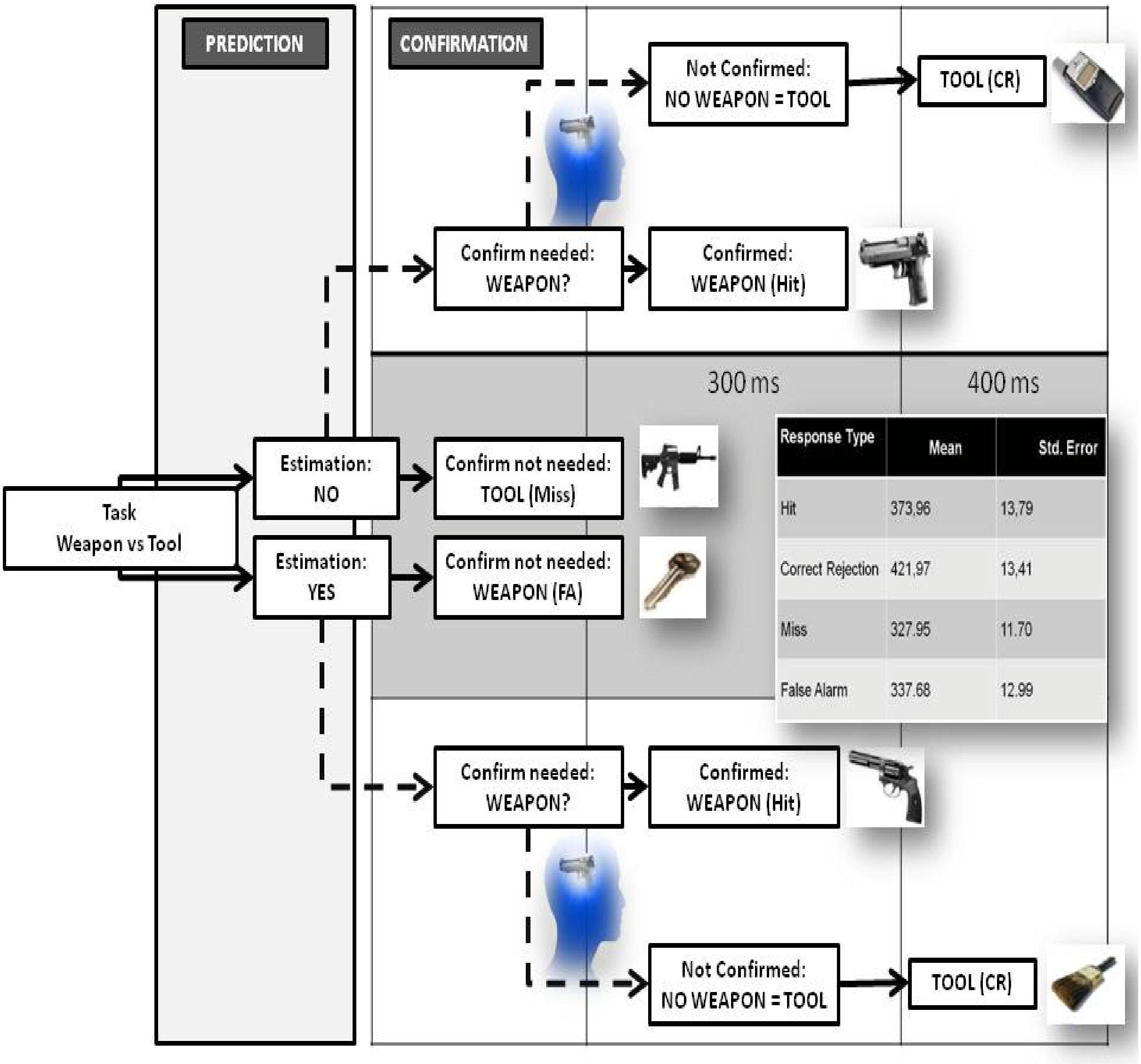


Figure 3. 15 Schema for Prediction-Confirmation Hypothesis.

[12] http://cogno-bytes.com/2010/04/15/perception-and-object-recognition/

Task 2 (Arousal = Low)

Two analyses of variance (ANOVA) were computed for each dependent variable:

1. Valence of the IAPS pictures (Valence), Ethnicity of the prime (Ethnicity) and Type of response (RType, only for RTs) for all the responses;
2. Valence of the IAPS pictures (Valence), Ethnicity of the prime (Ethnicity) and Type of object-target (Object, only for RTs) for corrected responses.

The design included, respectively, one or two within-subjects factors:

1. Valence of the IAPS pictures (Valence), Ethnicity (Black, White, and Neutral) for SDT parameters, and (Hit, CR, Miss, FA) for RTs;
2. Valence of the IAPS pictures (Valence), Ethnicity (Black, White, and Neutral) for SDT parameters, and Object (weapon and tool) for RTs.

Reaction Times (RTs)

Results of the analysis of variance (ANOVA) for the two within-subjects factors Valence (Negative and Positive) and RType (Hit, CR, Miss, FA) of control trials (Neutral Prime) show participants' RTs significantly differed in relation to the RType they gave [F (3, 105) = 9.260, p < .001] (see Table 3.5 for Means and S.E., p. 60).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RType on CR responses as compared to Miss [F (1, 35) = 6.357, p < .05] with a medium effect size (r = .39).

No significant effect for Hit responses as compared to CR [F (1, 35) = 2.368, p = n.s] and Miss as compared to FA was found [F (1, 35) = .726, p = n.s.].

The analysis of variance (ANOVA) for the three within-subjects factors Valence (Negative and Positive), Ethnicity (Black, White, and Neutral) and RType (Hit, CR, Miss, FA) showed participants' RTs significantly differed in relation to the RType they gave [F (3, 78) = 8.492, p < .001] (see Table 3.6 for Means and S.E., p. 60).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RType on CR responses as compared to Miss [F (1, 26) = 4.704, p< .05], with a medium effect size (r = .39).

No significant effect for Hit responses as compared to CR [F (1, 26) = 3.571, p = n.s.]; Miss as compared to FA was found [F (1, 26) = .483, p = n.s.].

The second repeated measures analysis of variance (ANOVA) performed on mean RTs for each ethnicity (Ethnicity) – Object type (Object) combination after having dropped RTs for incorrect responses (35%) as in Payne (2001) for the three within-subjects factors Valence (Negative and Positive), Ethnicity (Black, White, and Neutral) and Object (weapon and tool) show participants' RTs significantly differed in relation to the Object [F (1, 45) = 10.676, p < .005; r = .44] (see Table 3.7 for Means and S.E., 60).

Moreover, results show participants' RTs were affected by the interaction between Ethnicity and the Object [F (2, 90) = 8.345, p < .001] (see Table 3.8 for Means and S.E., p. 60).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of Object on weapon responses as compared to Tool when presented after Black Prime [F (1, 45) = 8.803, p = .005], with a medium effect size (r = .40).

Difference on RTs for weapon responses as compared to tool when presented after White Prime was not significant [F (1, 45) = 1.081, p = n.s.].

Tables for RTs: Task 2, Study 1 (Means and S.E)

RTYPE	MEAN (ms)	S.E.
Hit	389	17.513
CR	371* r = .39	16.521
Miss	338	19.301
FA	328	14.607

Table 3. 5 Response Type: RT Means and S.E. for control trials (Task 2).

RTYPE	MEAN (ms)	S.E.
Hit	358	19.865
CR	347* r = .39	20.184
Miss	321	18.641
FA	316	15.846

Table 3. 6 Response Type: RT Means and S.E. for complete data (Task 2).

OBJECT	MEAN (ms)	S.E.
Weapon	403** r = .44	14.879
Tool	390	14.988

Table 3. 7 Object: RT Means and S.E. for correct responses (Hit and CR, Task 2).

ETHNICITY	OBJECT	MEAN (ms)	S.E.
Black	Weapon	384* r = .40	15.603
	Tool	400	17.491
White	Weapon	415	16.954
	Tool	381	15.404
Neutral	Weapon	410	15.077
	Tool	390	14.305

Table 3. 8 RT Means and S.E. for the interaction between Ethnicity and the Object (Task 2).

<u>*SDT Parameters*</u>

Results of the analysis of variance (ANOVA) for the two within-subjects factors Valence (Negative and Positive) and Ethnicity (Black, White, and Neutral) show participants' Hit Rate (HRate) was affected by the interaction between Valence and Ethnicity of the prime [F (2, 96) = 3.098, p = .05] (see Table 3.9 for Means and S.E., p. 61).
Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented before Black Prime compared to Neutral Prime in HRate [F (1, 48) = 5.403, p< .05], with a medium effect size (r = .32); whereas the difference was not significant when Negative IAPS pictures were presented before White Prime compared to Neutral Prime in HRate [F (1, 48) = .162, p = n.s.].

Results of the same analysis for FA rates (FARates) show participants' FARates was affected by the interaction between Valence and Ethnicity [F (2, 96) = 4.124, p < .05] (see Table 3.10 for Means and S.E.).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented before Black Prime compared to Neutral Prime in FARates [F (1, 48) = 5.545, p< .05], with a medium effect size (r = .32); whereas the difference was not significant when Negative IAPS pictures were presented before White Prime compared to Neutral Prime in FARates [F (1, 48) = .232, p = n.s.].

Tables for Hit & FA: Task 2, Study 1 (Means and S.E)

VALENCE	ETHNICITY	MEAN	S.E.
Negative	Black	.702* r = .32	.029
	White	.653	.028
	Neutral	.619	.030
Positive	Black	.618	.031
	White	.648	.030
	Neutral	.628	.032

Table 3.9 Valence*Ethnicity: Hit Rate Means and S.E. for the interaction (Task 2).

VALENCE	ETHNICITY	MEAN	S.E.
Negative	Black	.390* r = .32	.031
	White	.302	.025
	Neutral	.323	.030
Positive	Black	.293	.033
	White	.345	.029
	Neutral	.345	.028

Table 3. 10 FA Rate Means and S.E. for the interaction between Ethnicity and Valence (Task 2).

*Criterion (**c**)*

Results of the analysis of variance (ANOVA) for the two within-subjects factors Valence (Negative and Positive) and Ethnicity (Black, White, and Neutral) show participants' *criterion* (***c***) was affected by the interaction between Valence and Ethnicity [F (2, 96) = 6.861, p < .005] (see Table 3.11 for Means and S.E. and Graphic 3.1 p. 62).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented before Black Prime compared to Neutral Prime in *criterion* (***c***) [F (1, 48) = 9.683, p< .005], with a medium effect size (r = .41); whereas the difference was not significant when Negative IAPS pictures were presented before White Prime compared to Neutral Prime in Hit rate [F (1, 48) = .0, p = n.s.].

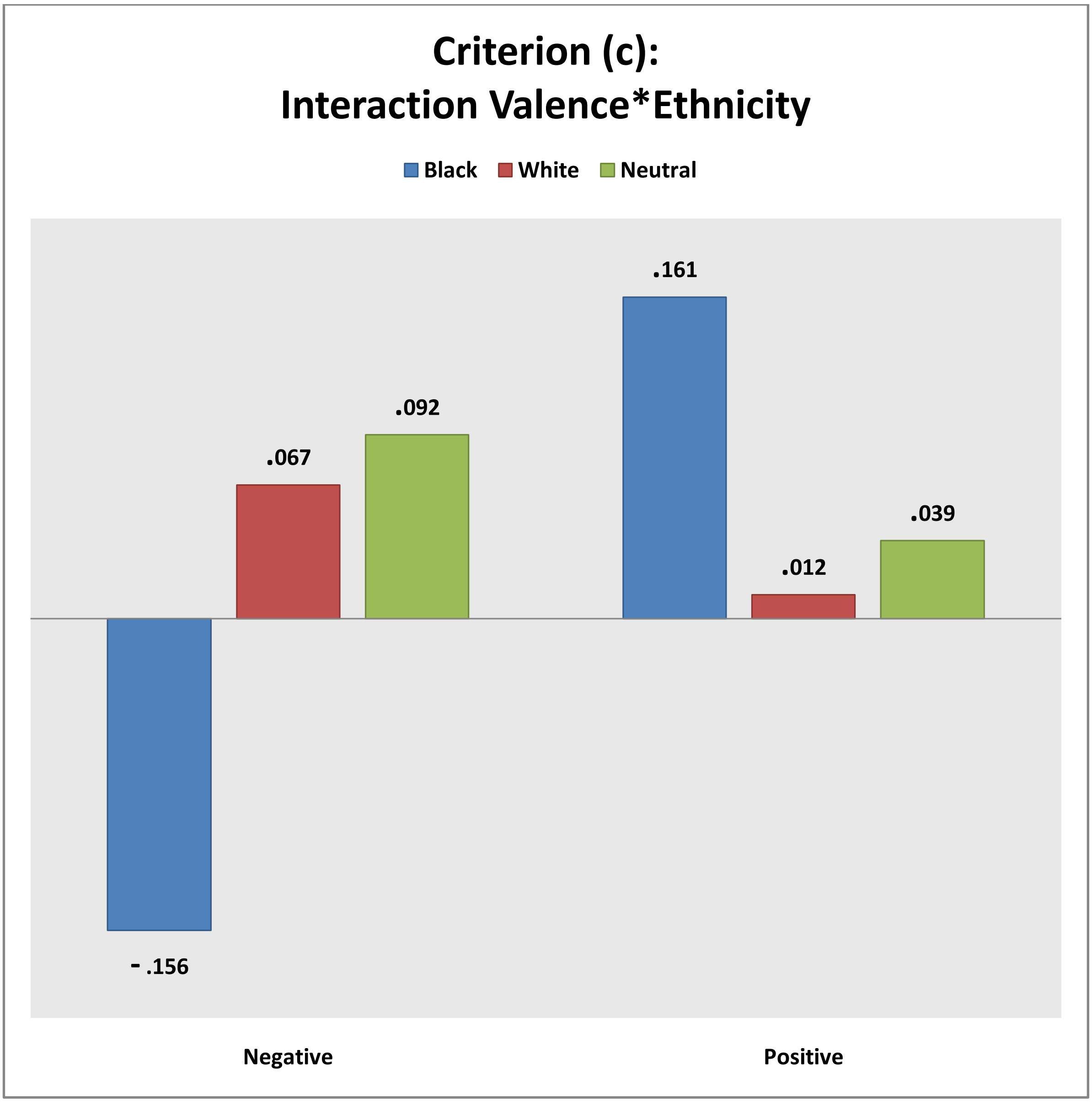
No other significant main effects or interactions were found.

Tables for Criterion: Task 2, Study 1 (Means and S.E)

VALENCE	ETHNICITY	MEAN	S.E.
Negative	Black	-.156* r = .41	.063
	White	.067	.063
	Neutral	.092	.064
Positive	Black	.161	.052
	White	.012	.047
	Neutral	.039	.065

Table 3. 11 *c* values Means and S.E. for the interaction between Ethnicity and Valence (Task 2).

Graphic for criterion c values: Task 2, Study 1.



Graphic 3.1 *Criterion* (*c*): Graph for the interaction between Valence and Ethnicity (Study 1, Task 2).

<u>*Discussion (Study 1 - Task 2)*</u>

Whereas, as in Task 1, a significant difference was found on RTs between correct responses compared with Miss and False Alarms, the difference in latencies between Hits and Correct Rejections was not significant. Moreover, the effect of the Object decreased from large to medium in the three analyses (Neutral Prime Trial, Complete data and correct responses alone; Task 1 r = .82; r = .87 and r = .77 *vs* Task 2 r = .40; r = .39 and r = .44). Furthermore, contrary to Task 1 of the previous study, RT means show that weapons identification latencies (Hits) were longer than tool identification latencies (CR) in the three analyses.

The tendency is clarified by results of the interaction between Ethnicity and Object. In fact, it is interesting to note that, for correct responses, Whites and Neutrals seem to show a difference in RTs contrary to results showed in Task 1. Moreover, RT means for Blacks are comparable with results as explained by the model highlighted for Task 1 and reported in Picture 3.15 (p. 58).

Implicitly, the presentation of other stimuli, namely low arousal pictures of different valence and type, affects RTs in general, and specifically interacting selectively with the ethnicity of the prime.

An explanation could be found in SDT parameters analysis. In fact, intriguingly, the presentation of IAPS pictures before the WIT affected participants' Hit and FA Rates and *criterion* (***c***).

Specifically, negative valenced pictorial presentation before Black primes had a significant effect on participants' Hit and FA Rates, meaning their ability to correctly detect weapons was enhanced as well as, conversely, their tendency to misperceive common objects (i.e, tools), seeing weapons instead.

That is, IAPS pictures' valence significantly affected the ability to correctly categorize weapons only when it interacted with Black primes. On the contrary, negative valenced IAPS pictures generally decreased the number of mistakes in misperception of weapons (FA) but this tendency was not shown for Blacks. In fact, negative valenced IAPS pictures interacted with Blacks, increasing significantly the misperception of weapons.

Results mean that participants in negative affect state were sensitive to the ethnicity of the prime and, according to the racial bias hypothesis (Correll, Park, Judd, & Wittenbrink, 2002; Correll et al., 2007; Payne, 2001), the stereotype activation made participants more ready in identifying weapons as well as more prone to misperceive objects as dangerous.

Furthermore, the bias displayed on Hit and FA Rates is confirmed by the analysis of *criterion* (***c***) values.

In fact, a significant difference was found in *c* values when negative valenced IAPS pictures were presented before Black primes. Negative valenced IAPS pictures seem to dramatically enhance the tendency to detect weapons for Blacks whereas they act as contrast for the others (i.e. Whites and Neutrals), increasing the tendency to have a conservative attitude.

Thus, results support the hypothesis that presentation of IAPS pictures, even with low level of arousal, made stereotypes available affecting RTs, Hit and FA rates, and *criterion* (***c***).

Moreover, evidence was found for the hypothesis that negativity of environmental stimuli is enough to affect decision behaviour under time pressure.

It is interesting to note that only correct responses were affected by the valence of the IAPS pictures.

Moreover, results could be the evidence that the anticipation of the process of mental construction of images, based on the search and use of cues dispersed in long-term memory (Marucci, 2009), depends on the affect state. Positive affect state stimulates conservative behaviour and draws attention to non-dangerous objects, and, thanks to the mental reconstruction, makes tools more available for the matching process.
Schema proposed in Picture 3.15 (p. 58) could be modified in the confirmation mental image construction according to the affect state (see Picture 3.16). Matching and confirmation processes would be subsequent to the confronting images affecting RTs accordingly.

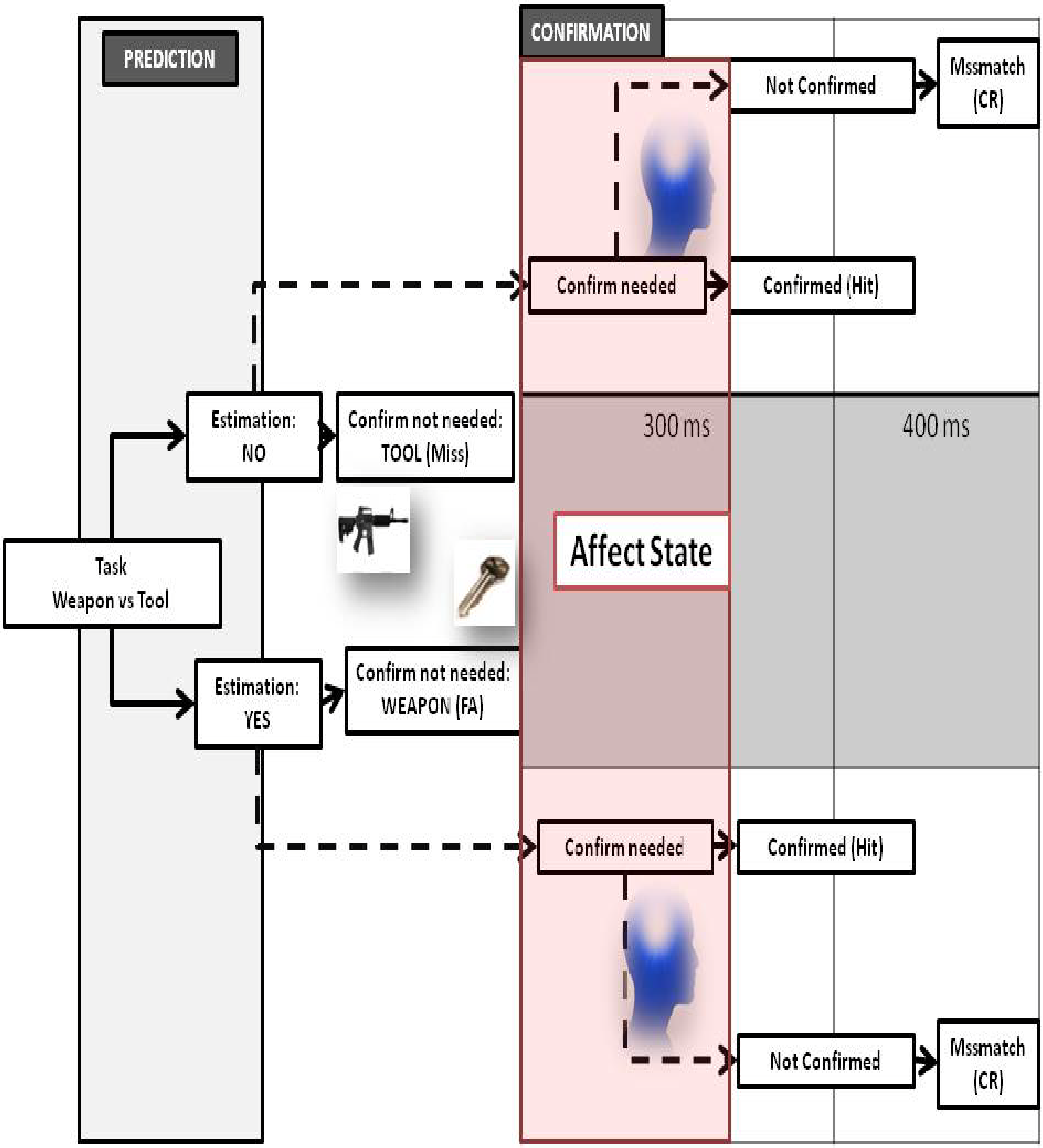


Figure 3.16 Modified schema for Prediction-Confirmation Hypothesis.

Task 3 (Arousal = High)

As for Task 2, two analysis of variance (ANOVA) were computed for each dependent variable:

1. Valence of the IAPS pictures (Valence), Ethnicity of the prime (Ethnicity) and Type of response (RType, only for RTs) for all the responses;
2. Valence of the IAPS pictures (Valence), Ethnicity of the prime (Ethnicity) and Type of object-target (Object, only for RTs) for corrected responses.

The design included, respectively, one or two within-subjects factors:

1. Valence of the IAPS pictures (Valence), Ethnicity (Black, White, and Neutral) for SDT parameters, and (Hit, CR, Miss, FA) for RTs;
2. Valence of the IAPS pictures (Valence), Ethnicity (Black, White, and Neutral) for SDT parameters, and Object (weapon and tool) for RTs.

Reaction Times (RTs)

Results of the analysis of variance (ANOVA) for the two within-subjects factors IAPS pictures' Valence (Negative and Positive) and RType (Hit, CR, Miss, FA) of control trials (Neutral Prime) show participants' RTs significantly differed in relation to the RType they gave [$F(3, 96) = 6.389$, $p = .001$] (see Table 3.12 for Means and S.E., p. 66).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RType on CR responses as compared to Miss [$F(1, 32) = 7.154$, $p < .05$] with a medium effect size ($r = .43$). No significant effect was found for Hit responses as compared to CR [$F(1, 32) = .099$, p = n.s] and for Miss as compared to FA [$F(1, 32) = .078$, p = n.s.].

The analysis of variance (ANOVA) for the three within-subjects factors Valence (Negative and Positive) , Ethnicity (Black, White, and Neutral) and RType (Hit, CR, Miss, FA) showed participants' RTs significantly differed in relation to the RType they gave [$F(3, 75) = 9.699$, $p < .001$] (see Table 3.13 for Means and S.E., p. 66).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of type of response on: CR responses as compared to Miss [$F(1, 25) = 9.572$, $p = .005$], with a large effect size ($r = .53$). No significant effect for Hit responses as compared to CR [$F(1, 25) = .308$, p = n.s.]; Miss as compared to FA was found [$F(1, 25) = .102$, p = n.s.].

The second repeated measures analysis of variance (ANOVA) performed on mean RTs for each ethnicity (Ethnicity) – Object type (Object) combination, after having dropped RTs for incorrect responses (29%) as in Payne (2001) for the three within-subjects factors Valence (Negative and Positive), Ethnicity (Black, White, and Neutral) and Object (weapon and tool), show participants' RTs significantly differed in relation to the Object [$F(1, 47) = 8.297$, $p < .01$; $r = .39$] (see Table 3.14 for Means and S.E., p. 66).

Moreover, results show participants' RTs were affected by the interaction between Valence and the Object [$F(1, 47) = 7.921$, $p < .01$, $r = .39$] (see Table 3.15 for Means and S.E., p. 66).

Tables for RTs: Task 3, Study 1 (Means and S.E)

RTYPE	MEAN (ms)	S.E.
Hit	372	18.366
CR	376* r = .43	18.877
Miss	334	16.149
FA	338	15.931

Table 3. 12 RT Means and S.E. for control trials (Task 3).

RTYPE	MEAN (ms)	S.E.
Hit	351	16.776
CR	348* r = .53	18.511
Miss	323	13.094
FA	321	13.407

Table 3. 13 RT Means and S.E. for complete sample data (Task 3).

OBJECT	MEAN (ms)	S.E.
Weapon	408* r = .39	15.084
Tool	396	14.862

Table 3. 14 RT Means and S.E. for correct responses (Hit and CR, Task 3).

VALENCE	OBJECT	MEAN (ms)	S.E.
Negative	Weapon	406	15.162
	Tool	402	15.339
Positive	Weapon	410	15.493
	Tool	389	14.701

Table 3. 15 RT Means and S.E. for the interaction between Ethnicity and Object (Task 3).

SDT Parameters

Results of the analysis of variance (ANOVA) for the two within-subjects factors Valence (Negative and Positive) and Ethnicity (Black, White, and Neutral) show participants' HRate was affected by the interaction between Valence and Ethnicity [F (2, 96) = 4.714, p < .05] (see Table 3.16 for Means and S.E., p. 67).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented before Black Prime compared to Neutral Prime in Hit rate [F (1, 48) = 6.280, p< .05], with a medium effect size (r = .34); whereas the difference was not significant when Negative IAPS pictures were presented before White Prime compared to Neutral Prime in HRate [F (1, 48) = .366, p = n.s.].

Results of the same analysis for FARates showed participants' FARates significantly differed in relation to the Ethnicity [F (2, 96) = 3.280, p < .05] (see Table 3.17 for Means and S.E.). Moreover, participants' FARates were affected by the interaction between Valence and Ethnicity [F (2, 96) = 7.063, p = .001] (see Table 3.18 for Means and S.E.).
Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented before Black Prime compared to Neutral Prime in FARates [F (1, 48) = 12.885, p = .001], with a medium effect size (r = .46); whereas the difference was not significant when Negative IAPS pictures were presented before White Prime compared to Neutral Prime in FARates [F (1, 48) = 3.514, p = n.s.].

Tables for Hit & FA: Task 3, Study 1 (Means and S.E)

VALENCE	ETHNICITY	MEAN	S.E.
Negative	Black	.739* r = .34	.024
	White	.686	.028
	Neutral	.676	.030
Positive	Black	.644	.029
	White	.685	.027
	Neutral	.692	.032

Table 3. 16 Hit Rate Means and S.E. for the interaction between Ethnicity and Valence (Task 3).

ETHNICITY	MEAN	S.E.
Black	.305	.021
White	.261	.019
Neutral	.294	.023

Table 3. 17 FA Rate Means and S.E. for the Ethnicity (Task 3).

VALENCE	ETHNICITY	MEAN	S.E.
Negative	Black	.348** r = .46	.026
	White	.274	.022
	Neutral	.274	.023
Positive	Black	.262	.022
	White	.248	.023
	Neutral	.314	.029

Table 3. 18 FA Rate Means and S.E. for the interaction between Ethnicity and Valence (Task 3).

*Criterion (**c**)*

Results of the analysis of variance (ANOVA) for the two within-subjects factors Valence (Negative and Positive) and Ethnicity (Black, White, and Neutral) show participants' *criterion* (***c***) was affected by the interaction between Valence and Ethnicity [F (2, 96) = 9.730, p < .001] (see Table 3.19 for Means and S.E. and Graphic 3.2).

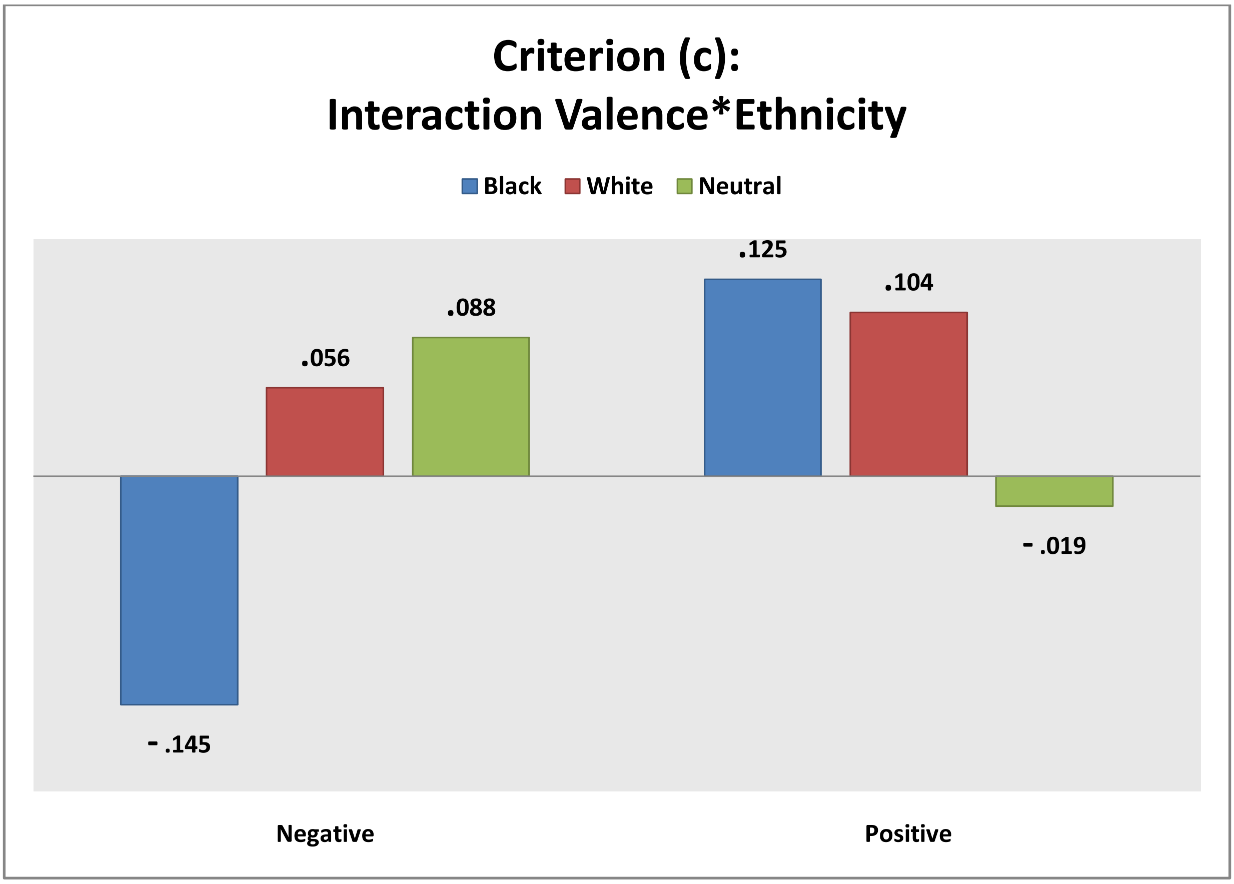
Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented before Black Prime compared to Neutral Prime in *criterion* (***c***) [F (1,48) = 15.761, p < .001], with a large effect size (r = .50); White Prime compared to Neutral Prime in Hit rate [F (1,48) = 4.502, p< .05], with a medium effect size (r = .29).

No other significant main effects or interactions were found.

VALENCE	ETHNICITY	MEAN	S.E.
Negative	Black	-.145** r = .50	.040
	White	.056* r = .29	.037
	Neutral	.088	.044
Positive	Black	.125	.051
	White	.104	.050
	Neutral	-.019	.052

Table 3. 19 *c* values Means and S.E. for the interaction between Ethnicity and Valence (Task 3).

Graphic for criterion c values: Task 3, Study 1.



Graphic 3.2 *Criterion* (*c*): Graph for the interaction between Valence and Ethnicity (Study 1, Task 3)

Discussion (Study 1 – Task 3)

Whereas, in general, RTs analysis for Task 3 did not show dramatic differences as compared to Task 2, an interesting interaction was found between IAPS pictures' Valence and the Object on correct responses. In fact, RT means show that negative valence (High arousal values for this task) seems to reduce the difference of means of latencies in detecting weapons and tools but, conversely, positive valenced IAPS pictures seem to enhance RTs in detecting tools. Therefore, arousal level seems to influence the effect of valence in detecting objects differently: negative valenced IAPS pictures reduce the difference in detecting lethal objects as compared to common objects, whereas positive valenced IAPS pictures increase only the velocity to detect tools.

Thus, high arousal values in pictorial stimuli presented before the WIT interacted with the valence of the same stimuli differently. In fact, high arousal negative affect state seems to level the difference in detection latencies between weapons and tools, whereas high arousal positive affect state enhances latencies in detecting tools.

Moreover, no racial bias was found, in contrast with results of Task 2, on reaction times.

Furthermore, SDT parameter analyses' results for Task 3 are very similar to results for Task 2, despite the fact that Hit rates means increased and FA rates means decreased.

It is perhaps the evidence that the ability to correctly discriminate between weapons and tools is enhanced by the arousal state even if no significant difference was found on ***d'*** between Task 2 and Task 3 (low arousal pictorial stimuli *vs* high arousal).

Whereas negative valenced IAPS pictures, as for Task 2, negatively interacted with Blacks enhancing FA rates, ethnicity effect increased with arousal level of the IAPS pictures.

Criterion (***c***) analysis also revealed an interaction between IAPS pictures' Valence and ethnicity of the prime, and negative valenced IAPS pictures had an interaction with Whites, decreasing significantly *criterion* (***c***) values. Furthermore, the effect size of Ethnicity on *criterion* (***c***) values for the interaction between negative valenced IAPS pictures and Blacks was increased from medium to large (Task 2 $r = .41$; Task 3 $r = .50$).

Thus, results support the hypothesis that arousal generally enhances performance but interacts selectively with Valence and Ethnicity.

In fact, arousal seems, specifically when interacting with negative pictorial stimuli, to amplify the magnitude of racial bias. It could happen because it makes more salient ethnical information of the stimuli.

Moreover, the schemas proposed are not violated.

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General Discussion (Study 1)

Study 1 was designed to investigate if emotion components (valence and arousal) affect performance in RTs, *criterion* (***c***) and sensitivity (***d'***) in a categorization task such as the Payne WIT (2001).
To this aim prime and target stimuli were selected in a pre-test phase and three evaluative priming tasks were implemented as in the Payne study of 2001.
In this study Neutral primes were introduced as control condition and in Task 1 the Payne WIT (2001) was replicated and used as control to be confronted with Tasks 2 and 3 in which IAPS pictures were used, manipulating valence and arousal level, to elicit emotions before the main task.
To put time pressure on participants the 700 ms deadline (Payne, Lambert, & Jacoby, 2002) was chosen and the task was studied in order to force participants into a really challenging chain of rapid categorization of objects in two categories: weapon or tool.
Confronting results of Task 1 of this study and the results from Payne (2001, 2006) and Payne, Lambert, & Jacoby (2002) studies, it could be said that results were partially replicated although ethnicity of the prime has had no effect either on RTs or on SDT parameters (Hit and FA rates, ***c*** and ***d'***).
The absence of the effect of ethnicity was explained with the selection of the stimuli procedure. In fact, prime stimuli were selected in order to avoid criminal-violence-ethnicity stereotype activation. Therefore, results support implicitly the racial bias hypothesis (Correll, 2008; Correll, Park, Judd, & Wittenbrink, 2002; Correll et al., 2007; Correll, Wittenbrink, Park, Judd, & Goyle, 2011; Donders, Correll, & Wittenbrink, 2008; Greenwald, Oakes, & Hoffman, 2003; Ma & Correll, 2011; Payne, 2001, 2005, 2006; Payne, Lambert, & Jacoby, 2002; Payne, Shimizu, & Jacoby, 2005; Plant & Peruche, 2005; Plant, Peruche, & Butz, 2005; Sim & Correll, 2009) in the way that, eliminating stimuli (primes) that were categorized as highly possibly violent criminals, the schema that linked Black primes to violence and crime concepts was inhibited or avoided. Or, alternatively, by the fact participants have had experienced experiments using similar paradigms supporting the hypothesis that exposure to this task eliminates the response bias (Plant, Peruche, & Butz, 2005).
Analysis of RTs of correct responses, in part, replicated the findings of previous studies with similar aims showing participants were faster in categorizing weapons than tools whereas no significant Ethnicity effects or interactions were found on RTs.
Analysis of the four types of possible responses to this kind of task (Hit, Correct Rejection, Miss, and False Alarm) revealed a significant difference in RTs between correct responses (Hits and Correct Rejections) and responses where objects were misperceived (Misses and False Alarms). In fact, wrong responses were given significantly faster without any latency difference within them (Miss latencies = FA latencies), whereas a significant difference was found within correct responses (Hit latencies < CR latencies).
These results were again explained with the Prediction-Confirmation Hypothesis within which, in a double-level decision process, mistakes were the result of a faster and lower level decision process where probability computational strategy was adopted by participants to enhance their velocity to respond. This strategy was not influenced by the object but perhaps

by the experience and previous trials outcomes, and did not need any confirmation or incremental information.

Differences within correct responses, on the other hand, were, according to the proposed hypothesis, the result of a higher level decision process in which a confirmation was needed before any decision was taken. This kind of decision was affected by the object and needed at least a few cues or information that participants extracted from target pictorial stimuli. This strategy was adopted at the expense of latencies but was successful in correct responses. The differences within correct responses were explained with the hypothesis that participants were more weapon-oriented (***Weapon Offset***) since weapons represent threats and, according to the Evolutionary Threat Hypothesis, are detected faster. In addition, differences were explained with the hypothesis that images are the result of mental constructions based on the search and use of dispersed cues in long-term memory where familiar (or more salient) objects are more easily reconstructed (Marucci, 2009).

This hypothesis was tested throughout the entire research and any eventual violation addressed.

In Tasks 2 and 3 of this study, IAPS pictures were presented before the main WIT. The two tasks, however, differed in the IAPS pictures' level of arousal, but were similar in the presentation of two categories of stimuli: positive and negative.

In general, IAPS picture presentation before the main task, either arousing or not, positive or negative, affected RTs interacting selectively with the ethnicity of the prime.

It is interesting to note that participants presented with IAPS pictures before the main task, in contrast with the control condition (Task 1), displayed a racial bias in their response latencies and SDT parameters.

In fact, negative valenced IAPS pictures dramatically enhanced the ***Weapon Offset*** (i.e., the tendency to detect weapons and misperceive tools as weapons) only when primed with Blacks.

Moreover, whereas the Prediction-Confirmation Hypothesis was violated for Whites and Neutrals, for Blacks it was not.

A modification to the Prediction-Confirmation Hypothesis schema was proposed to account for the Task 2 results that take into consideration the affect state at the moment of the decision. In fact, results support the hypothesis that positive affect states stimulate conservative behaviour, drawing attention to non-dangerous objects (tools) making them more available for the matching process. In general, with the double-level process the differences between responses (correct and wrong) are explained. More specifically, with the second level of decision process, conceived as a confirmation-matching phase where the confrontation of iconic mental images is constructed according to the affect state and stimuli presented, the differences within correct responses (Hit and Correct Rejections) are clarified. That is, positive affect state and non-Black primes increase the possibility that non-weapon images were used as matching reference. Conversely, negative affect states and Blacks made weapon iconic images more available. Latencies and SDT parameters resulted accordingly.

Moreover, arousal seemed to have played a different role. In fact, it generally enhanced performance but interacted selectively with other variables such as Valence and Ethnicity.

As predicted, negative-arousing stimuli decreased significantly the criterion adopted for White targets, that is, increased response bias toward Whites. At the same time, racial bias *per* *se* toward Blacks was enhanced (larger effect size). Since the response bias toward Whites underwent a significant increase, in comparison with that of the Blacks, the racial bias was reduced.

Arousal seems to mainly interact with negative affect states making non-essential information more salient.

Therefore, to sum up, results support the hypothesis that participants responded to the WIT according to a double-level decision process in order to enhance their efficiency in categorising objects. They used a lower level of decision process, faster and probability-based, mostly founded on experience and likelihood estimation of future presentation of the objects. When they were confident with their estimation, faster responses were provided but were mostly wrong. When participants were not confident enough with their estimation, they increased their attention in order to capture object information, at the expense of latencies, and being more ready to recognize weapon-like objects because they were more weapon-oriented (***Weapon Offset***). Responses, in this second higher level of decision process, were given according to a faster matching evaluation (weapon-like - weapon) and a slower mismatching comparison (weapon-like – non-weapon). Affect states, either arousing or not, affected the availability of the iconic object to be compared in the second level of decision process. Affect state seems to have had no effect on fast probability estimation responses whereas it affected the ability to process and capture successfully information. Affect states seem to have influenced the reconstruction of mental images to be used in the matching phase, making either weapon-like or tool-like available for the confrontation. Positivity enhanced the probability that tool-like confrontation would be performed, whereas negativity increased the weapon-like matching process. Matching responses were faster whereas mismatching responses were slower.

It will have to be explained if different kinds of negative stimuli (i.e., pictures of physical assaults, car accidents or natural disasters), either high arousing or not, affect differently the decision process, that is, if other nested characteristics of stimuli should be considered within the same arousal level and valence.

To this aim Study 2 was designed.

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Study 2

Everyone knows what attention is. It is the taking possession of the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration, of consciousness are of its essence (James, 1890, pp. 403-404).

Moreover, an important distinction made by James (1890), and still important in recent research and theorising, should be made by ***Active Attention***, controlled and based on top-down processes, and ***Passive Attention***, controlled by external stimuli and based on bottom-up processes (Eysenck & Keane, 2005).

Furthermore, three major components of attention were individuated by Posner & Petersen (1990): Alerting, Orienting and Executive Control.

The three components are respectively responsible for the enhancing of performance on sensory processing tasks modulating non selectively the attention (***Alerting***), the allocation shifting to new locations (***Orienting***), and to demands conflict resolving with the inhibition of dominant response tendency (***Executive Control***) (Schimmack & Oishi, 2005).

The simplest evaluation that could be given to a stimulus is whether it is positive or negative and it is worth assuming that negative stimuli are more critical for survival, thus, they automatically attract attention.

Humans could have adapted in the simplest way, developing an undemanding mechanism that automatically detects all negative stimuli even if not all negative stimuli threaten survival (Schimmack & Oishi, 2005).

Pratto and John (1991), from a set of studies in which response latencies were affected in the same way by slightly as well as extremely undesiderable words, found support for the ***Categorical Negativity Theory***.

However, Mogg, Bradley, Field, & and De Houwer (2003) found that more extreme negative pictures attract more attention than milder ones, whereas mild negative pictures did not attract more attention than positive pictures (Schimmack, 2005).

On the other hand, Anderson (2003) and Buodo, Sarlo, & Palomba (2002) found that positive erotic stimuli attracted attention more than some negative stimuli.

Furthermore, F. Pratto found that arousing positive words, such as “kissing”, affected the negative bias making it disappear, concluding that *it remains to be seen whether special classes of positive stimuli might also be attention grabbing* (F. Pratto, 1994, p. 125).

Empirical evidence from studies with visual search tasks demonstrated that participants are faster in detecting threats, such as a snake in array with mushrooms than one mushroom in array with snakes (Schimmack & Oishi, 2005), or angry faces in array with happy faces than *vice versa* (Hansen & Hansen, 1988).

These results support the ***Evolutionary Threat Hypothesis*** that suggests humans developed a specific detection mechanism for threatening to survival stimuli.

Thus, affect selectively influences attention when threatening to survival stimuli (i.e., snakes, spiders, or angry faces, etc.) are detected.

Furthermore, Schimmack & Oishi (2005), in two studies, used a set of pictures obtained from the ***International Affective Picture System*** (IAPS; P.J. Lang, Bradley, & Cuthbert, 1999) to manipulate the level of valence, level of arousal and evolutionary threat value in order to determine the affective attribute of emotional pictures that predict interference effect (Schimmack & Oishi, 2005).

Results failed to find a significant effect of the type of pictures (neutral *vs* evolutionary threat) and were in line with other studies with similar stimuli (Kindt & Brosschot, 1999; P.J. Lang, Bradley, & Cuthbert, 1999).

However, Schimmack & Oishi (2005) found, interestingly, that evolutionary threat pictures had a weaker effect than could be predicted by the arousal ratings.

These findings suggest that dissociation between arousal ratings and behavioural measures of attention could be produced by this type of stimuli.

According to Schimmack & Oishi (2005), the dissociation between arousal ratings and behavioural measures of attention could be given by considering that humans developed a flexible system of stimuli evaluation open to learning.

Experience and learning could have given to humans the ability to discriminate between truly threatening stimuli and only negative stimuli after an assessment of their significance. That is, what guides attention, causing interference effects, is not the automatic assessment of the valence of a stimulus (Schimmack & Oishi, 2005).

Moreover, according to Schimmack & Oishi (2005) findings, the interference effects could be predicted by pictures' arousal level suggesting that arousal is the first appraisal of a stimulus.

On the other hand, the ***Sequential Evaluation Check Model*** proposed by Scherer (2001) suggests stimuli are sequentially evaluated not starting automatically from the evaluation of the valence or threat but rather, determining how relevant the event is for the person.

The nature of the unfolding emotion process is influenced, according to Scherer, by the initial relevance check and the consequential regulation of attention to detect the stimuli's characteristics (Scherer, 2001).

There is empirical evidence that relevance is a predictor of attention allocation (Dalgleish, 1995; Mogg, Bradley, Field, & and De Houwer, 2003).

However, relevance is a complex construct and more studies are needed to elucidate the situation-specific and general determinants of relevance since virtually the relevance of any stimulus varies according to the situational factors and personal evaluation (Schimmack & Oishi, 2005).

It also remains to be determinate why strong unpleasant pictures, such as guns and victim of violence, and pictures of opposite-sex models tend to be more relevant than other pictures. Although the findings seem to be consistent with the everyday observation that sex and violence never cease to attract people's attention, it remains to be explained why this is the case (Schimmack & Oishi, 2005, p. 65).

Thus, the aim of this study is to try to answer the question proposed by Schimmack (2005): to investigate if different types of pictorial stimuli affect differently RTs or SDT parameters in the Weapon Identification Task.

According to the Sequential Evaluation Check Model proposed by Scherer (2001) IAPS picture of assaults would affect the magnitude of effects already highlighted in the previous study.

Methods

<u>Participants and design</u>

Fifty-seven US citizens (56 born in USA; 34 Afro-American, 15F, 19M; 23 White-American, 11F, 12M; M=22.2; SD= 2.89) participated in return for $6.

<u>Stimuli (Prime and Target)</u>

Prime and Target stimuli were digitalized photographs 5.3 x 4 cm in size (Payne, 2001). Prime stimuli included twelve White and twelve Black faces and target stimuli included eight Weapons and eight Tools.

<u>Stimuli (International affective picture system - IAPS; Lang, Bradley, and Cuthbert, 2008)</u>

Four groups of 6 digitalized 20 x 16 cm in size IAPS pictures were created. Stimuli were selected according to IAPS standard ratings, as reported in Table 3.20, and the groups, homogeneous for valence and arousal, named as follows:

a) Group 1 (H_A): Arousal = High, Affective Valence = Negative and Content = Armed Violence
b) Group 2 (H_P1): Arousal = High, Affective Valence = Positive and Content = People/Sport
c) Group 3 (H_V): Arousal = High, Affective Valence = Negative and Content = Physical Violence
d) Group 4 (H_P2): Arousal = High, Affective Valence = Positive and Content = People/Sport

	(G1)H_A		**(G2)H_P1**		**(G3)H_V**		**(G4)H_P2**	
	3500		8030		3180		5470	
	3530		8178		3181		8080	
	6243		8185		6312		8180	
	6244		8186		6315		8200	
	6313		8370		6360		8380	
	6540		8400		6530		8470	
	Val	**Aro**	**Val**	**Aro**	**Val**	**Aro**	**Val**	**Aro**
M	2.27	6.54	7.21	6.94	2.33	6.02	7.51	6.25
SD	0.44	0.56	0.45	0.30	0.27	0.52	0.23	0.34

Table 3. 20 IAPS pictures selected Means and SD for Valence and Arousal (Study 2)[13].

[13] *International Affective Picture System:* Male subjects (2005, Picture sets 1-16). International Affective Picture System (IAPS): Technical Manual and Affective Ratings. (Lang, P.J., Bradley, M.M., and Cuthbert, B.N. 2005)

Procedure

The same procedure as in Study 1 was used but Task 1 was skipped and trials of Tasks 2 and 3 were incremented from 132 to 144.

Moreover, for *Stimulus categorization phase 1 and 2* participants, were requested to categorize twelve pictures (two rounds of six each, balanced in their affective valence values and with equal means of arousal value ratings) according to their representation for the participants (Group 1/3 respectively *vs* Group 2/4).

As in Study 1, after the selection phase the pictures were presented alternated in their affective valence value (Positive/Negative/Positive/Negative, etc.) to participants' full screen size and participants had the opportunity to watch the pictorial stimuli at their own peace.

Thus, to summarize, the experiment proceeded with the following phases:

1. Personal data recording (demographics and SAM 1)
2. Training trials
3. Stimuli categorization (Random: High or Low Arousal)
4. Priming Task (according to preceding phase: Task 1 or 3)
5. SAM (2)
6. Stimuli categorization (according to preceding phase: High or Low Arousal)
7. Priming Task (according to preceding phase: Task 1 or 3)
8. SAM (3)

Design

The design of the experiment was:

a) For **Task 1** (AROUSAL = Low): VALENCE (Positive *vs* Negative = Assault) x 3 ETHNICITY (Black, White, and Neutral) x (only for RTs) 4 TYPE OF RESPONSE (Hit, CR, Miss, and FA) or 2 OBJECT (weapon *vs* tool).

b) For **Task 2** (AROUSAL = High): VALENCE (Positive *vs* Negative = Armed Assault) x 3 ETHNICITY (Black, White, and Neutral) x (only for RTs) 4 TYPE OF RESPONSE (Hit, CR, Miss, and FA) or 2 OBJECT (weapon *vs* tool).

SDT (Hit rate, FA rate, ***c*** and ***d'***) parameters were computed.

Results

Due to technical problems the responses of six subjects were not recorded.

A priori it was decided not to record responses given after the timeout for each trial for the three tasks and to record responses given before the presentation of the target as "0", recoded then as system-missing value for the analysis. Moreover, subjects with less than 70% of responses recorded (or system-missing value) and 60% of medium latencies as outliers were discharged.

As a result one subject for Task 1 and two for Task 2 were discharged by data analysis resulting in a loss of data of 2.6% for Task 1, 3.1% for Task 2. Thus, final analysis was performed on data recorded for 48 subjects for Task 1 and 49 subjects for Task 2.

Analysis of RTs on correct responses solely comported the exclusion of 32% of data for Task 1 and 34% for Task 2.

Latencies were log-transformed then averaged for each condition. Supplemental analyses performed on untransformed data produced very similar results. Results are reported in milliseconds (ms) for reaction times and untransformed for SDT parameters.

[Significance is reported in tables with * for p < .05 and ** for p < .001]

Task 1 (Arousal = Low; Negative IAPS = Assault)

Two analyses of variance (ANOVA) were computed for each dependent variable:

1. Valence of the IAPS pictures (Valence), Ethnicity of the prime (Ethnicity) and Type of response (RType, only for RTs) for all the responses;
2. Valence of the IAPS pictures (Valence), Ethnicity of the prime (Ethnicity) and Type of object-target (Object, only for RTs) for corrected responses.

The design included, respectively, one or two within-subjects factors:

1. Valence (Negative and Positive), Ethnicity (Black, White, and Neutral) for SDT parameters, and (Hit, CR, Miss, FA) for RTs;
2. Valence (Negative and Positive), Ethnicity (Black, White, and Neutral) for SDT parameters, and Object (weapon and tool) for RTs.

Reaction Times (RTs)

Results of the analysis of variance (ANOVA) for the two within-subjects factors Valence (Negative and Positive) and RType (Hit, CR, Miss, FA) of control trials (Neutral Prime) show participants' RTs significantly differed in relation to the RType they gave [$F(3, 99) = 16.103$, $p < .001$] (see Table 3.21 for Means and S.E., p. 81).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RType on CR responses as compared to Miss [$F(1, 33) = 25.854$, $p < .001$] with a large effect size ($r = .66$).

No significant effect for Hit responses as compared to CR [$f(1, 33) = .833$, p = n.s.]; Miss as compared to FA was found [$F(1, 33) = .759$, p = n.s.].

Moreover, results of the analysis of control trials (Neutral Prime)_show participants' RTs significantly differed in relation to the Valence [$F(1, 33) = 4.579$, $p < .05$] with a medium effect size ($r = .35$) (see Table 3.22 for Means and S.E., p. 81).

Furthermore, results of the analysis of the control condition (Non-Prime trials) show participants' RTs were affected by the interaction between Valence and RType [$F(3, 99) = 3.310$, $p < .05$] (see Table 3.23 for Means and S.E., p. 121).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented on: Hit responses as compared to CR [$F(1, 33) = 6.196$, $p < .05$], with a medium effect size ($r = .40$); CR responses as compared to Miss [$F(1, 33) = 9.411$, $p < .005$], with a medium effect size ($r = .47$).

No significant effect for Miss responses as compared to FA [$F(1, 33) = 3.516$, p = n.s.].

The analysis of variance (ANOVA) for the three within-subjects factors Valence (Negative and Positive), Ethnicity (Black, White, and Neutral) and RType (Hit, CR, Miss, FA) showed participants' RTs significantly differed in relation to the RType they gave [$F(3, 87) = 35.071$, $p < .001$] (see Table 3.24 for Means and S.E., p. 122).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RType on: Hit responses as compared to CR [F (1, 29) = 6.492, p< .05], with a medium effect size (r = .42); CR responses as compared to Miss [F (1, 29) = 51.107, p < .001] with a large effect size (r = .80).
No significant effect for Miss as compared to FA was found [F (1, 29) = .035, p = n.s.].
Results of the analysis of variance (ANOVA) for the two within-subjects factors Valence (Negative and Positive) and Ethnicity (Black, White, and Neutral) show participants' RTs were affected by the interaction between Valence and RType [F (3, 87) = 4.651, p = .005] (see Table 3.25 for Means and S.E., p. 122).
Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented on: Hit responses as compared to CR [F (1, 29) = 11.779, p < .005], with a large effect size (r = .54); CR responses as compared to Miss [F (1, 29) = 5.155, p < .05], with a medium effect size (r = .39).
Not significant difference was found on RTs when Negative IAPS pictures were presented on Miss responses as compared to FA [F (1, 29) = 3.561, p = n.s.].
The second repeated measures analysis of variance (ANOVA) performed on mean RTs for each Ethnicity – Object type (Object) combination after having dropped RTs for incorrect responses (32%) as in Payne (2001) for the three within-subjects factors Valence (Negative and Positive), Ethnicity (Black, White, and Neutral) and Object (weapon and tool) show participants' RTs significantly differed in relation to the Object [F (1, 45) = 20.341, p < .001; r = .56] (see Table 3.26 for Means and S.E., p. 122).
Moreover, results show participants' RTs were affected by the interaction between Valence and Ethnicity [F (1, 45) = 4.348, p < .05] (see Table 3.27 for Means and S.E., p. 123).
Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented before Black Prime compared to Neutral Prime in RTs [F (1, 45) = 5.101, p< .05], with a medium effect size (r = .32); when Negative IAPS pictures were presented before White Prime compared to Neutral Prime [F (1, 45) = 7.608, p< .01], with a medium effect size (r = .37).
Moreover, results show participants' RTs were affected by the interaction between Valence and the Object [F (1, 45) = 25.121, p < .001, r = .60] (see Table 3.28 for Means and S.E., p. 123).
Furthermore, results show participants' RTs were affected by the interaction between Valence, Ethnicity and the Object [F (2, 90) = 3.238, p < .05, r = .60] (see Table 3.29 for Means and S.E., p. 124).
Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented before Black Prime compared to Neutral Prime on weapon identification [F (1, 45) = 5.500, p < .05], with a medium effect size (r = .33); whereas RTs did not differ significantly when Negative IAPS pictures were presented before White Prime compared to Neutral Prime on weapon identification [F (1, 45) = .300, p = n.s.].

Tables for RTs: Task 1, Study 2 (Means and S.E)

RTYPE	MEAN (ms)	S. E.
Hit	410	16.132
CR	402** r = .66	15.898
Miss	360	13.222
FA	351	12.904

Table 3. 21 Response Type: RT Means and S.E. for control trials (Task 1).

VALENCE	MEAN (ms)	S. E.
Negative	386* r = .35	13.331
Positive	376	13.360

Table 3. 22 Valence: RT Means and S.E. for control trials (Task 1).

VALENCE	RTYPE	MEAN (ms)	S.E.
Negative	Hit	408* r = .40	14.795
	CR	419* r = .47	17.822
	Miss	354	14.658
	FA	361	16.546
Positive	Hit	411	18.626
	CR	385	15.860
	Miss	366	13.755
	FA	342	11.505

Table 3. 23 Valence*Ethnicity: RT Means and S.E. for control trials (Task 1).

Tables for RTs: Task 1, Study 2 (Means and S.E)

RTYPE	MEAN (ms)	S.E.
Hit	394* r = .42	15.920
CR	382** r = .80	16.699
Miss	340	13.414
FA	341	13.219

Table 3. 24 Response Type: RT Means and S.E. for complete data (Task 1).

VALENCE	RTYPE	MEAN (ms)	S.E.
Negative	Hit	386* r = .54	15.154
	CR	391* r = .39	17.801
	Miss	337	14.570
	FA	349	13.843
Positive	Hit	402	17.398
	CR	373	15.944
	Miss	342	13.532
	FA	333	13.566

Table 3. 25 Means and S.E. for the interaction between Ethnicity and the Object (Task 1).

OBJECT	MEAN (ms)	S.E.
Weapon	431** r = .56	14.182
Tool	414	14.137

Table 3. 26 Object: RT Means and S.E. for correct responses (Hit and CR, Task 1).

Tables for RTs: Task 1, Study 2 (Means and S.E)

VALENCE	ETHNICITY	MEAN (ms)	S.E.
Negative	Black	418* r = .32	15.949
	White	412* r = .37	41.267
	Neutral	437	14.452
Positive	Black	420,584	15,306
	White	424,133	13,842
	Neutral	423,063	14,244

Table 3. 27 Valence*Ethnicity: RT Means and S.E. for the interaction between Ethnicity and Valence (Task 1).

VALENCE	OBJECT	MEAN (ms)	S.E.
Negative	Weapon	423	13.990
	Tool	423	15.033
Positive	Weapon	440	14.848
	Tool	405	13.483

Table 3. 28 Valence*Object: RT Means and S.E. for the interaction (Task 1).

Tables for RTs: Task 1, Study 2 (Means and S.E)

VALENCE	ETHNICITY	OBJECT	MEAN (ms)	S. E.
Negative	Black	Weapon	407* r = .33	14.538
		Tool	429	18.431
	White	Weapon	420	15.112
		Tool	405	14.268
	Neutral	Weapon	440	15.862
		Tool	434	15.119
Positive	Black	Weapon	441	17.198
		Tool	399	14.767
	White	Weapon	439	15.225
		Tool	409	13.832
	Neutral	Weapon	439	16.261
		Tool	407	13.719

Table 3. 29 Valence*Ethnicity*Object: RT Means and S.E. for the interaction (Task 1).

<u>*SDT Parameters*</u>

Results of the analysis of variance (ANOVA) for the two within-subjects factors Valence (Negative and Positive) and Ethnicity (Black, White, and Neutral) show participants' Hit Rate (HRate) significantly differed in relation to the Valence [F (1, 47) = 6.894, p < .05, r = .32] (see Table 3.30 for Means and S.E., p. 84).

Moreover, results show participants' Hit Rate (HRate) was affected by the interaction between Valence and Ethnicity of the Prime [F (2, 94) = 4.315, p = .05] (see Table 3.1 for Means and S.E., p. 84).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented before Black Prime compared to Neutral Prime in HRate [F (1, 47) = 5.654, p< .05], with a medium effect size (r = .33); whereas the difference was not significant when Negative IAPS pictures were presented before White Prime compared to Neutral Prime in HRate [F (1, 47) = .026, p = n.s.]. Results of the same analysis for FA rates (FARates) show participants' FARates were affected by the interaction between Valence and Ethnicity [F (2, 94) = 8.314, p < .001] (see Table 3.32 for Means and S.E., p. 84).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented before Black Prime compared to Neutral Prime in FARates [F (1, 47) = 11.478, p < .005], with a medium effect size (r = .44); whereas the difference was not significant when Negative IAPS pictures were presented before White Prime compared to Neutral Prime in FARates [F (1, 47) = .031, p = n.s.].

Tables for Hit & FA: Task 1, Study 2 (Means and S.E)

VALENCE	MEAN	S.E.
Negative	.698* r = .32	.023
Positive	.655	.026

Table 3. 30 Valence: Hit Rate Means and S.E. (Task 1).

VALENCE	ETHNICITY	MEAN	S. E.
Negative	Black	.741* r = .33	.026
	White	.673	.029
	Neutral	.680	.030
Positive	Black	.635	.030
	White	.665	.030
	Neutral	.666	.029

Table 3. 31 Valence*Ethnicity: Hit Rate Means and S.E. for the interaction (Task 1).

VALENCE	ETHNICITY	MEAN	S.E.
Negative	Black	.366* r = .44	.029
	White	.276	.025
	Neutral	.302	.028
Positive	Black	.267	.022
	White	.301	.026
	Neutral	.334	.030

Table 3. 32 Valence*Ethnicity: FA Rate Means and S.E. for the interaction (Task 1).

*Criterion (**c**)*

Results of the analysis of variance (ANOVA) for the two within-subjects factors Valence (Negative and Positive) and Ethnicity (Black, White, and Neutral) show participants' *criterion* (***c***) was affected by the interaction between Valence and Ethnicity [F (2, 94) = 11.032, p < .001] (see Table 3.33 for Means and S.E. and Graphic 3.3).

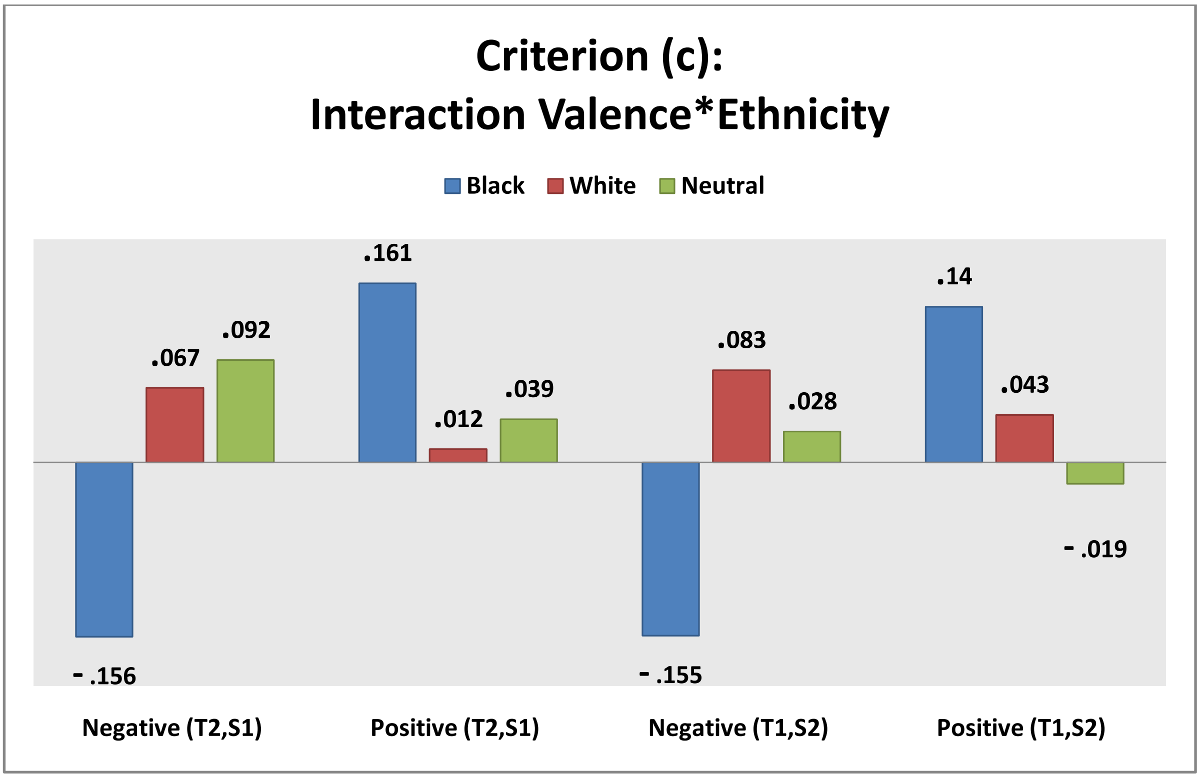
Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented before Black Prime compared to Neutral Prime in *criterion* (***c***) [F (1, 47) = 14.265, p < .001], with a medium effect size (r = .48); whereas the difference was not significant when Negative IAPS pictures were presented before White Prime compared to Neutral Prime in Hit rate [F (1, 47) = .007, p = n.s.].

No other significant main effects or interactions were found.

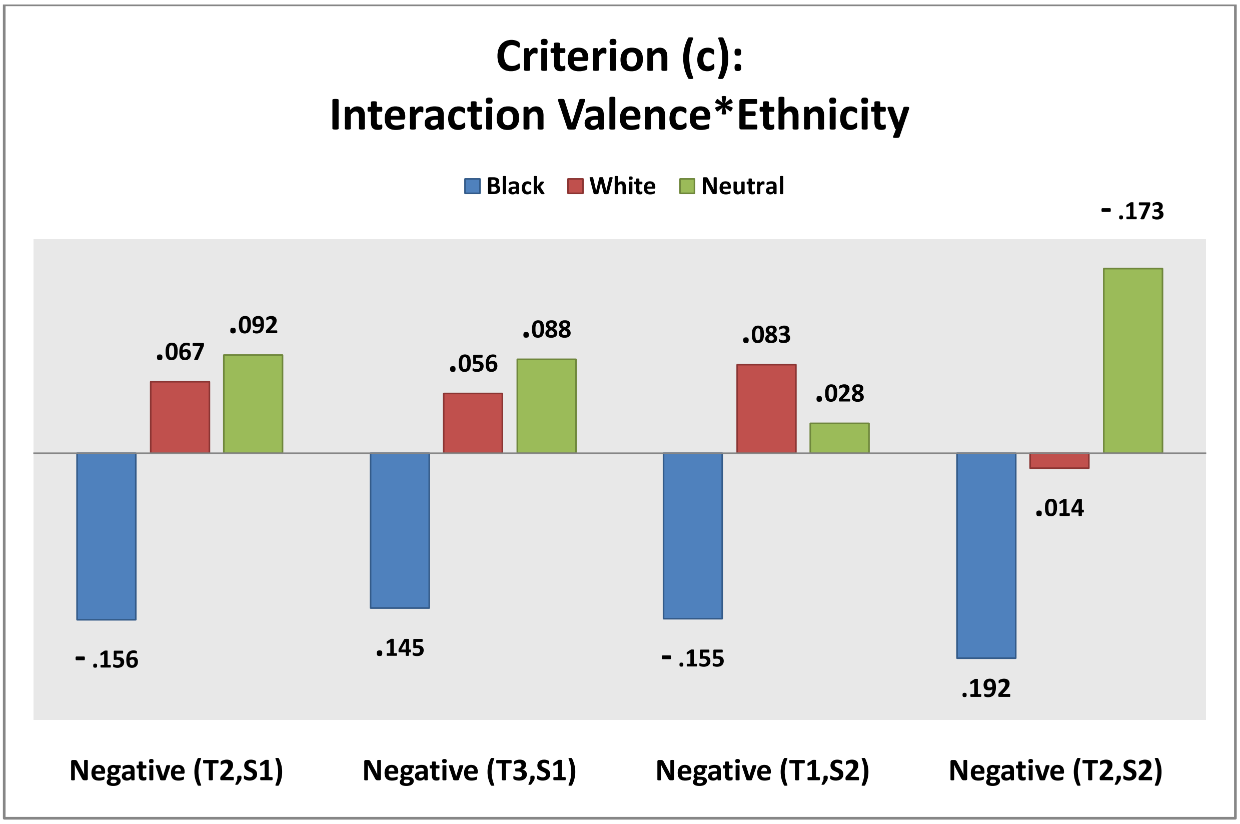
VALENCE	ETHNICITY	MEAN	STD. ERROR
Negative	Black	-.155** 48	.059
	White	.083	.046
	Neutral	.028	.053
Positive	Black	.140	.044
	White	.043	.049
	Neutral	-.019	.055

Table 3. 33 Valence*Ethnicity: *c* values Means and S.E. for the interaction (Task 1)

Graphic for criterion c values: Study 1 vs Study 2.



Graphic 3.3 *Criterion* (*c*): Graph of the interaction between Valence and Ethnicity (Study 1 *vs* Study 2).



Graphic 3.4 *Criterion* (*c*): Graph of the interaction between Valence and Ethnicity (Study 1 *vs* Study 2).

Discussion (Study 2 - Task 1)

Differences in response latencies already discussed for Study 1 were found in this study. Thus, only new findings are discussed in this section. The complete comparative analysis between Studies 1 and 2 will be reported in the general discussion at the end of this chapter.

It is worth remembering that Task 1 of this study was similar to Task 2 of the previous study but with a difference in the type of IAPS pictures for negative valenced ones. In fact, negative valenced IAPS pictures were representing physical assault situations (low arousal level). Specifically pictures of physical assault without weapons were selected.

It is to be noted that in the analysis of latencies for control trials (Neutral Prime) the significant difference found between correct responses (Hit and CR) and wrong ones (Miss and FA) differed in the magnitude of the effect size as compared to Task 2 of Study 1. In fact, in this study the effects size of the type of response was significantly larger than in the previous study (Study 1, Task 2 $r = .39$; Study 2, Task 1 $r = .66$).

Moreover, other differences on control trials (Neutral Prime) were found for this task as compared to Task 2 of Study 1; in fact, an interesting main effect of Valence and a significant interaction of Valence and Response Type on RTs for control trials (Neutral Prime) were found.

This is the evidence that different types of IAPS pictures with the same values of valence differ in their effect on latencies.

Generally, negative valenced IAPS pictures negatively affect reaction times and specifically they are particularly effective on Correct Rejections (Positive condition = 385 ms; Negative condition = 419 ms), as clarified by the significant interaction that was found between Response Type and Valence.

The tendency displayed for Task 1 of Study 1 seems to be replicated only for trials where negative valenced IAPS pictures were presented before the WIT. In fact, weapon identification (Hit responses) was significantly shorter than tool identification latencies (Correct Rejections), whereas when positive valenced IAPS pictures were presented the tendency was the opposite. Moreover, a significant difference was found between correct responses as compared to wrong and, furthermore, no difference was found within wrong responses (Miss and FA). In general, means of latencies are also longer.

Results support the hypothesis that valence *per se* is not enough to affect reaction times in a categorization task. In fact, in Task 2 of Study 1, the effect of valence (IAPS pictures were represented by general negative impersonal stimuli) on RTs in the control trials (when primes were represented only by neutral pictures, see figure 3.6, p.44) was not significant, whereas they were significant on RTs in this task when negative IAPS pictures were represented by physical assaults.

Analysis of complete data revealed an amplification of the effect size (Task 2 of Study 1 $r = .39$; Task 1 of Study 2 $r = .80$) which showed a significant difference between correct responses as compared to wrong ones.

Moreover, a significant difference was found within correct responses, that is, between weapon identification (Hit) as compared to tool identification (CR) with a slight increase of the effect size. Furthermore, correct response analysis showed the general tendency found in Task 2 of Study 1 where weapon identification was slower than tool identification.

Moreover, results showed Valence interacted with Object, Prime and Prime and Object together.

Interestingly, negative valenced IAPS pictures levelled latencies in both weapon and tool identification (weapon = 423 ms; tool = 423 ms). Moreover, positive valenced IAPS pictures affected differently RTs in tool identification. In fact, whereas positive valenced IAPS pictures negatively affected weapon categorization, they positively affected tool categorization (weapon = 440 ms; tool = 405 ms).

Furthermore, weapon identification, confirming the tendency as illustrated in Study 1, General Discussion, was significantly faster only for the conditions where negative valenced IAPS pictures were presented before Blacks.

Intriguingly, results showed negative valenced IAPS pictures significantly enhanced Hit Rates as compared to positive ones. In addition, whereas the same interaction between Valence and Ethnicity was found on Hit rates in Task 2 of Study 1, in this task values were increased.

The same could be said for FA rates, despite the fact that values were lower as compared to Task 2 of Study 1.

Once more, support for the hypothesis that valence *per se* is not enough to affect reaction times in a categorization task results of Hit rates in this task were significantly enhanced by negative valenced IAPS pictures represented by physical assault. On the contrary, in Task 1 of Study 1 Hit rates were not affected by generic impersonal negative valenced IAPS pictures.

Racial bias was shown in this task as in Task 2 of Study 1 but values show that the types of IAPS pictures have different effects in their interaction with Neutral Prime and Whites but have the same effect in their interaction with Blacks.

Thus, results support the hypothesis that the type of IAPS pictures presented before the WIT increases the effect of valence of pictorial stimuli at low levels of arousal.

Moreover, results also support the hypothesis that stimuli are sequentially evaluated, determining how relevant the event for the person is and not starting automatically from the evaluation of the valence. Moreover, some more evidence was found to give support to the hypothesis that the unfolding emotion process is influenced by the initial relevance check and the consequential regulation of attention to detect the stimuli’s characteristics (Sherer, 2001).

Task 2 (Arousal = High; Negative IAPS = Armed Assault)

Two analyses of variance (ANOVA) were computed for each dependent variable:

1. Valence of the IAPS pictures (Valence), Ethnicity of the prime (Ethnicity) and Type of response (RType, only for RTs) for all the responses;
2. Valence of the IAPS pictures (Valence), Ethnicity of the prime (Ethnicity) and Type of object-target (Object, only for RTs) for corrected responses.

The design included, respectively, one or two within-subjects factors:

1. Valence (Negative and Positive), Ethnicity (Black, White, and Neutral) for SDT parameters, and (Hit, CR, Miss, FA) for RTs;
2. Valence (Negative and Positive), Ethnicity (Black, White, and Neutral) for SDT parameters, and Object (weapon and tool) for RTs.

Reaction Times (RTs)

Results of the analysis of variance (ANOVA) for the two within-subjects factors IAPS pictures' Valence (Negative and Positive) and RType (Hit, CR, Miss, FA) of control trials (Neutral Prime) show participants' RTs significantly differed in relation to the RType they gave [F (3, 108) = 20.847, p < .001] (see Table 3.34 for Means and S.E., p. 91).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference in Hit responses as compared to CR [F (1, 36) = 4.203, p < .05] with a medium effect size (r = .32); CR responses as compared to Miss [F (1, 36) = 23.620, p < .001] with a large effect size (r = .63).

No significant effect was found for Miss as compared to FA [F (1, 36) = .144, p = n.s.].

Furthermore, results of the analysis of control trials (Neutral Prime) show participants' RTs were affected by the interaction between Valence and RType [F (3, 108) = 3.457, p < .05] (see Table 3.35 for Means and S.E., p. 91).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented on Hit responses as compared to CR [F (1,36) = 7.830, p < .01], with a medium effect size (r = .42).

No significant effect for CR responses as compared to Miss [F (1, 36) = .423, p = n.s.]; Miss responses as compared to FA [f (1, 36) = 1.533, p = n.s.].

The analysis of variance (ANOVA) for the three within-subjects factors Valence (Negative and Positive) , Ethnicity (Black, White, and Neutral) and RType (Hit, CR, Miss, FA) showed participants' RTs significantly differed in relation to the RType they gave [F (3, 69) = 12.688, p < .001] (see Table 3.36 for Means and S.E., p. 91).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of type of response on: CR responses as compared to Miss [F (1, 23) = 14.846, p = .001] with a large effect size (r = .63).

No significant effect for Hit responses as compared to CR [f (1, 23) = 2.123, p= n.s.]; Miss as compared to FA was found [F (1, 23) = .471, p = n.s.].

Moreover, the analysis showed participants' RTs significantly differed in relation to the

Valence [F (1, 23) = 5.022, p < .05] with a medium effect size (r = .42) (see Table 3.37 for Means and S.E., p. 91).

The second repeated measures analysis of variance (ANOVA) performed on mean RTs for each ethnicity (Ethnicity) – Object type (Object) combination after having dropped RTs for incorrect responses (34%) as in Payne (2001) for the three within-subjects factors Valence (Negative and Positive), Ethnicity (Black, White, and Neutral) and Object (weapon and tool) show participants' RTs significantly differed in relation to the Object [F (1, 46) = 11.639, p = .001; r = .45] (see Table 3.38 for Means and S.E., p. 91).

Moreover, results show participants' RTs were affected by the interaction between Valence and the Object [F (1, 46) = 6.461, p < .05, r = .35] (see Table 3.39 for Means and S.E., p. 91).

Furthermore, results show participants' RTs were affected by the interaction between Valence, Ethnicity and Object [F (2, 92) = 8.888, p < .001] (see Table 3.40 for Means and S.E., p. 92).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented before Black Prime compared to Neutral Prime in RTs for weapon categorization [F (1, 46) = 15.287, p < .001], with a large effect size (r = .50); whereas the difference was not significant when Negative IAPS pictures were presented before White Prime compared to Neutral Prime in RTs for weapon categorization [F (1, 46) = 2.496, p = n.s.].

No other significant main effects or interactions were found.

Tables for RTs: Task 2, Study 2 (Means and S.E)

RTYPE	MEAN (ms)	S.E.
Hit	397* r = .32	18.004
CR	376** r = .63	17.849
Miss	329	14.666
FA	332	17.145

Table 3. 34 RT Means and S.E. for control trials (Neutral Prime) (Task 2).

VALENCE	RTYPE	MEAN (ms)	S.E.
Negative	Hit	414* r = .42	19.074
	CR	372	17.367
	Miss	318	14.003
	FA	335	18.475
Positive	Hit	381	19.079
	CR	381	19.120
	Miss	339	19.344
	FA	329	17.562

Table 3. 35 RT Means and S.E. for the interaction between Valence and the Response Type (Task 2).

RTYPE	MEAN (ms)	S.E.
Hit	345	20.533
CR	336** r = .63	19.734
Miss	302	16.684
FA	295	17.990

Table 3. 36 Response Type: RT Means and S.E. for complete data (Task 2).

Tables for RTs: Task 2, Study 2 (Means and S.E)

VALENCE	MEAN (ms)	S.E.
Negative	326* r = .42	17.512
Positive	313	18.559

Table 3. 37 Valence: RT Means and S.E (Task 2).

OBJECT	MEAN (ms)	S.E.
Weapon	410** r = .45	17.149
Tool	397	15.946

Table 3. 38 Object: RT Means and S.E. for correct responses (Hit and CR, Task 2).

VALENCE	OBJECT	MEAN (ms)	S.E.
Negative	Weapon	407	16.415
	Tool	404	16.822
Positive	Weapon	413	18.317
	Tool	389	15.337

Table 3. 39 Valence*Object: RT Means and S.E. for the interaction (Task 2).

Tables for RTs: Task 2, Study 2 (Means and S.E)

VALENCE	ETHNICITY	OBJECT	MEAN (ms)	S. E.
Negative	Black	Weapon	384** r = .50	17.937
		Tool	417	18.557
	White	Weapon	411	17.993
		Tool	402	16.914
	Neutral	Weapon	425	17.554
		Tool	392	17.179
Positive	Black	Weapon	414	19.406
		Tool	381	17.505
	White	Weapon	420	19.144
		Tool	399	14.328
	Neutral	Weapon	406	18.507
		Tool	389	16.663

Table 3. 40 Valence*Ethnicity*Object: RT Means and S.E. for the interaction (Task 2).

<u>*SDT Parameters*</u>

Results of the analysis of variance (ANOVA) for the two within-subjects factors Valence (Negative and Positive) and Ethnicity (Black, White, and Neutral) show participants' HRate were significantly affected in their reaction times by the Ethnicity [$F(2, 96) = 4.968$, $p < .01$] (see Table 3.41 for Means and S.E., p. 93).
Post hoc comparisons (Bonferroni corrected) revealed a significant difference of Black *vs* Neutral [$F(1, 48) = 9.559$, $P < .005$, $r = .41$]; whereas the difference of White *vs* Neutral was not significant [$F(1, 48) = 1.034$, P = n.s.].
Moreover, participants' HRate was affected by the interaction between Valence and Ethnicity [$F(2, 96) = 7.784$, $p = .001$] (see Table 3.42 for Means and S.E., p. 93).
Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented before Black Prime compared to Neutral Prime in Hit rate [$F(1, 48) = 16.439$, $p < .001$], with a large effect size ($r = .50$); White Prime compared to Neutral Prime in HRate [$F(1, 48) = 4.946$, $p < .05$] , with a medium effect size ($r = .30$).
Results of the same analysis for FARates showed FARates significantly differed in relation to the Valence [$F(1, 48) = 5.784$, $p < .05$, with a medium effect size ($r = .33$)] (see Table 3.43 for Means and S.E., p. 93).
Moreover, participants' FARates were affected by the interaction between Valence and Ethnicity [$F(2, 96) = 6.643$, $p < .005$] (see Table 3.44 for Means and S.E., p. 93).
Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented before Black Prime compared to Neutral Prime in FARates [$F(1, 48) = 10.952$, $p < .005$], with a large effect size ($r = .43$); White Prime compared to Neutral Prime in FARates [$F(1, 48) = 7.983$, $p < .01$], with a medium effect size ($r = .38$).

Tables for Hit & FA: Task 2, Study 2 (Means and S.E)

ETHNICITY	MEAN	STD. ERROR
Black	.687 * r = .41	.022
White	.646	.026
Neutral	.626	.029

Table 3. 41 Ethnicity: Hit Rate Means and S.E. (Task 2).

VALENCE	ETHNICITY	MEAN	S.E.
Negative	Black	.743** r = .50	.023
	White	.668* r = .30	.031
	Neutral	.605	.034
Positive	Black	.630	.030
	White	.625	.030
	Neutral	.646	.030

Table 3. 42 Valence*Ethnicity: Hit Rate Means and S.E. for the interaction (Task 2).

VALENCE	MEAN	S.E.
Negative - Crime	.333* r = .33	.021
Positive	.295	.022

Table 3. 43 Valence: FA Rate Means and S.E. (Task 2).

VALENCE	ETHNICITY	MEAN	S.E.
Negative	Black	.381* r = .43	.030
	White	.339* r = .38	.031
	Neutral	.280	.021
Positive	Black	.282	.030
	White	.274	.025
	Neutral	.329	.023

Table 3. 44 FA Rate Means and S.E. for the interaction between Valence and Ethnicity (Task 2).

*Criterion (**c**)*

Results of the analysis of variance (ANOVA) for the two within-subjects factors Valence (Negative and Positive) and Ethnicity (Black, White, and Neutral) show participants' *criterion* (***c***) was affected by the Valence [F (1, 48) = 8.772, p = .005], with a medium effect size (r = 39) (see Table 3.45 for Means and S.E., p. 94).

Moreover results show participants' *criterion* (***c***) was affected by the Ethnicity [F (2, 96) = 4.084, p = .05] (see Table 3.46 for Means and S.E., p. 94).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of Black *vs* Neutral [F (1, 48) = 6.582, P < .05, r = .35]; whereas the difference of White *vs* Neutral was not significant [F (1, 48) = .351, P = n.s.].

Furthermore, interaction between Valence and Ethnicity [F (2, 96) = 11.231, p < .001] was found on *criterion* (***c***) (see Table 3.47 for Means and S.E., p. 94).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Negative IAPS pictures were presented before Black Prime compared to Neutral Prime in *criterion* (***c***) [F (1,48) = 22.491, p< .001], with a large effect size (r = .56); White Prime compared to Neutral Prime in Hit rate [F (1,48) = 9.929, p< .005], with a medium effect size (r = .41).
No other significant main effects or interactions were found.

Tables for c* values*: Task 2, Study 2 (Means and S.E)

VALENCE	MEAN	S.E
Negative	-.011* r = .39	.023
Positive	.112	.036

Table 3. 45 Valence: *c* values Means and S.E. (Task 2).

ETHNICITY	MEAN	STD. ERROR
Black	-.023* r = .35	.033
White	.074	.034
Neutral	.100	.036

Table 3. 46 Ethnicity: *c* values Means and S.E. (Task 2).

VALENCE	ETHNICITY	MEAN	S. E.
Negative	Black	-.192** r = .56	.049
	White	-.014* r = .41	.054
	Neutral	.173	.050
Positive	Black	.146	.054
	White	.163	.047
	Neutral	.028	.044

Table 3. 47 Valence*Ethnicity: *c* values Means and S.E. for the interaction (Task 2).

Discussion (Study 2 - Task 2)

As for Task 1 of this study, differences in response latencies already discussed for Study 1 were minimal. Thus, only new findings are discussed in this section.

It is worth remembering that Task 2 of this study is similar to Task 3 of the previous study but with a difference in the type of IAPS pictures for negative valenced ones. In fact negative valenced IAPS pictures were representing physical assault situations. Specifically pictures of physical assault with weapons were selected.

As for Task 3 of Study 1 in control trials (Neutral Prime) a significant difference between correct responses as compared to wrong responses was found but the effect size increased (Task 3, Study 1 r = .43; Task 2, Study 2 r = .63) and a significant difference was found also between weapon (Hit) and tool (CR) identification latencies.

Furthermore, in control trials (Neutral Prime), an interaction was found between Valence and Response Types confirming that types of IAPS pictures have an effect on RTs (in this task IAPS pictures presented were High Arousal and negative valenced represented by armed assaults), but that no difference was found between armed assault and assaults without weapons.

Moreover, an increasing effect size of response type was found (Task 3, Study 1 r = 53; Task 2, Study 2 r = .63) on latencies for CR, that were significantly longer as compared to Miss.

Participants, in general, were significantly faster in correctly identifying objects. In addition, Tools were significantly identified as being faster than weapons but no significant difference was found in latencies of wrong responses (i.e., no difference was found between Miss and FA latencies).

Negative valenced IAPS pictures also seem to be responsible for this tendency.

Interestingly, whereas responses were generally faster after High Arousal IAPS pictures, as compared to Task 1 of this Study, negative valenced IAPS pictures negatively affected latencies (Positive = 313 ms; Negative = 326).

Moreover, the same interaction between Valence, Prime and Object on RTs was found in this task but the effect size was increased (Task 2 r = 32; Task 3 r = 50). That is, participants were significantly faster in detecting weapons only when negative valenced IAPS pictures were presented before Blacks; whereas in all the other conditions they were faster in identifying tools than weapons.

Results support the hypothesis that arousal enhances the readiness in categorizing stimuli but, strangely, not in correctly identifying weapons and tools.

The only condition where racial bias was shown in reaction times is when negative armed assault IAPS pictures were presented before primes and weapons. In this condition participants responded significantly faster in correctly categorizing weapons than tools, but this tendency was already shown in previous tasks and studies.

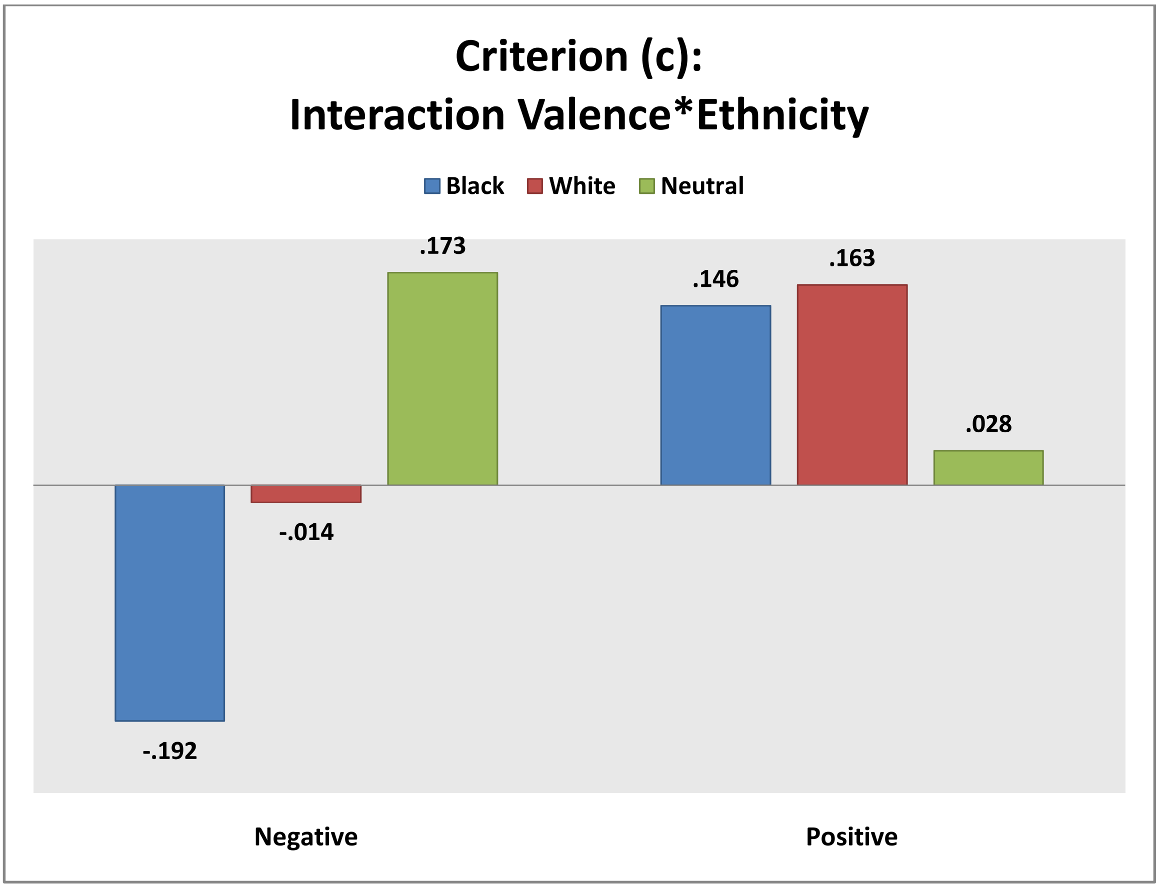
As for the previous study, Hit and FA rates were significantly affected by the Valence, the Ethnicity and their interaction.

In this task a racial bias was shown on Hit rates, particularly when negative IAPS pictures were presented before Blacks as compared to Neutrals.

Moreover, negative valenced IAPS pictures negatively affected FA Rates and specifically when presented before Blacks.

Intriguingly, *criterion* (***c***) values were significantly affected by the valence of IAPS pictures. In fact, in general, participants' criterion was significantly more weapon-oriented when presented with negative valenced IAPS pictures before the WIT as compared to positive condition (Positive *c* = .112; Negative *c* = - . 011).
Moreover, a racial bias toward Blacks was shown by *criterion* (***c***) values. In fact, ethnicity significantly affected *criterion* (***c***) values leading participants toward a more weapon-oriented attitude as compared to White and Neutral primes.
In this task an increase of effect size was found for the interaction between Valence and Ethnicity and interestingly a dramatic change in attitude was shown in the negative condition as compared to positive IAPS pictures presentation.
Results showed implicitly that the type of IAPS picture once more affected RTs, SDT parameters and criterion.
Moreover, results support the idea that more levels of differentiation could be found nested in negative valenced pictures.
As for arousal, type of pictures enhances the magnitude of their effect on RTs, SDT parameters and *criterion* (***c***).
Unfortunately, in this study it is not possible to selectively differentiate the effect of the type of IAPS pictures and the level of arousal on RTs and SDT parameters.

Graphic for criterion c values: Study 2.



Graphic 3.4 *Criterion* (*c*): Graph of the interaction between Valence and Ethnicity.

General Discussion (Study 2)

Study 2 was designed to investigate if diverse types of pictorial stimuli affect differently either RTs or SDT parameters in a task such as the WIT and if different kind of IAPS pictures would affect the magnitude of effects already highlighted in the previous study.
To this aim two WITs as in Task 2 and 3 of Study 1 were implemented.
IAPS pictures presented before the two categorization tasks were selected in order to present to participants pictures of assaults, scenes of beating or physical harassment for Task 1 and pictures of armed assaults for Task 2.
Deadline and experimental procedure was the same as in Study 1.
Indeed, as predicted, differences between correct responses and wrong ones in latency were found and the effects size increased significantly. Moreover, in this task, Valence affected significantly latencies. Specifically, negative valenced IAPS pictures negatively affected latencies perhaps because of their greater capability of capturing attention as compared to positive ones.
Results of Task 1 of Study 2 support the hypothesis that affect states determine the iconic mental image of the object used as a term of comparison for the matching phase. In fact, participants reacted differently according to their affective state: faster in identifying weapons when negatively stimulated and faster in identifying tools when positively stimulated.
Results of Study 2 support the hypothesis that valence *per se* is not enough to affect reaction times in a categorization task. In fact, when IAPS pictures were represented by general negative impersonal stimuli no effect was found in RTs (Task 2 of Study 1), whereas when negative IAPS pictures were represented by assaults: scenes of beating or physical harassment a significant effect was found on RTs (Task 1 of Study 2).
As predicted, the presentation of IAPS pictures represented by assaults, scenes of beating or physical harassment interacted with the object, the ethnicity of the prime and the two factors together affecting RTs. Moreover, the difference in latencies between weapon and tool identification was reduced and levelled. Furthermore, increases were found in Hit rates.
Results showed that type of the IAPS picture affected participants' performance even though, in this study, it is not possible to differentiate between the effect of the type of IAPS pictures and the level of arousal in RTs and SDT parameters between pictures of assaults, scenes of beating or physical harassment and pictures of armed assaults.
It is interesting that results support the idea that more levels of differentiation could be found nested in negative valenced pictures which, perhaps like arousal, enhance the magnitude of their effect on RTs, SDT parameters and *criterion* (***c***).

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Conclusions for the Weapon Identification Task (Studies 1 and 2)

The main aim of Studies 1 and 2 was to test whether the components of the emotions (Arousal and Valence), and content of stimuli (generic impersonal and physical assaults) were sufficient to alter the performance in a WIT (Payne, 2001).

To this purpose I investigated if affective valence, elicited with emotional pictures, could produce interference in the categorization task and if perception and attention could be influenced by emotional pictures. Arousal and valence were tested in isolation as well as in combination to investigate their eventual interaction on participants' performance. Moreover, differences between categories of a negatively valenced picture were tested.

One hypothesis was that arousal was sufficient to alter the perception of objects and that arousal cues were transferred from one arousing source (i.e., IAPS pictures) to another (i.e., prime) (Zillman, 1971). Secondly, it was argued that negative affect states could reduce, or even eliminate, the racial bias shifting the perceptual threshold for the categorization of weapons under time pressure.

As predicted, several variables affected RTs and SDT parameters in a task such as the WIT.

Visual perception and attention, specifically of object perception as either lethal or harmless in the studies proposed for this research, resulted as being affected by affective states and stereotypic associations.

Time is the worst enemy of the decision-maker. Deciding what is lethal or not in a split second could be an easy job unless social reasoning gets into the decision and not arousing, negative and specific-content relevant stimuli are perceived in the environment.

The two studies, taken together, suggest that affective states and associations between concepts and social groups influence decision-making and behaviour, working as visual tuning devices. Shifts in perception and attention interfere with associations and the organisation of visual stimuli leading perceivers to: being more accurate or conversely make more mistakes; reacting more slowly or being faster in object categorization.

In the non-IAPS picture control condition, participants displayed that ethnicity of the prime did not affect their performance and, consistently, have shifted their attention toward weapons.

It is difficult to determine if participants responded according to what they "saw or believed they saw". I argue that participants anticipated seeing the object they believed was the most likely to pop out according to their personal estimation of probability based on previous tasks. When this strategy was not considered efficient they anticipated seeing guns, because guns were the most relevant category in the task, and so they responded being motivated to identifying guns, enhancing their visual awareness, altering the threshold at which weapons would be detected. Thus, weapon-weapon association resulted faster than weapon-not weapon comparison but required, at least, the research of cues in the pictorial stimuli at the expense of latencies.

Pictorial stimuli presented before the main task had a dramatic effect on racial bias and object categorization.

The stereotypic association between the ethnicity of the prime and the object to be detected altered the threshold at which weapons were detected supporting the racial bias hypothesis. In fact, participants, after being activated with pictorial stimuli, arousing or not, displayed an attention-shifting toward weapons after Blacks, enhancing their readiness (shorter RTs), their ability in detecting weapons (higher Hit rates), their tendency to misperceive tools as guns (higher FA rates), and displaying a more liberal behaviour (lower criterion).

Whereas negative affect states negatively interacted with ethnicity displaying an association with Blacks, arousal amplified the magnitude of the effects.

Moreover, it seems that valence is only “a part of the whole picture”. In fact, results show that valence *per se*, in some situations, was not enough to affect reaction times unless negative IAPS pictures were represented by physical assaults, giving support to the idea that more levels of differentiation could be found nested in negative valenced pictures that, like arousal, enhance the magnitude of their effect on performance.

The studies presented were performed by US citizens, either Afro-American or White American, using an evaluative priming task and, whereas the use of other paradigms such as Correll et al.’s FPST is reported to produce results very similar, it is not reported in any research that they could be generalized to apply to other participant populations such as Italians and Italian police officers.

I strongly suspect Italians would display the same pattern of results, even if minority groups present on the Italian territory are the result of a completely different immigration history and they come from countries where morphologic characteristics are mostly the same.

Chapter IV

The First Person Shooting Task (FPST)

In February 1999, around midnight, four plain-clothes police officers were searching a Bronx, New York, neighbourhood for a rape suspect.
They saw Amadou Diallo, a 22-year-old West African immigrant, standing in the doorway of his apartment building. According to the police, Diallo resembled the suspect they were tracking.
When they ordered him not to move, Diallo reached into his pants pocket. Believing he was reaching for a gun, the police fired a total of 41 shots, 19 of which hit and killed Diallo. Diallo was in fact unarmed.
All four officers were later acquitted of any wrongdoing in the case. It seems crucial to understand whether or not the decision to shoot is influenced by the target's ethnicity, and, if so, what this bias represents (Correll, Park, Judd, & Wittenbrink, 2002, p. 1314).
Despite the same beginning, Payne (2001) and Correll, Park, Judd, & Wittenbrink (2002) approach the same problem from two different points of view.
Whereas the main purpose of Payne (2001) was to investigate response bias and objects identification when stereotypes are activated, Correll, Park, Judd, & Wittenbrink (2002) move their investigation further from weapon identification to the decision to shoot and the effect of target's ethnicity on the shooting decision.
Correll, Park, Judd, & Wittenbrink (2002) developed a videogame where images of African American and Whites, either armed or unarmed, would appear superimposed in different contexts. Behavioural responses were required as in a shooting incident: *shoot-don't shoot*.
Correll et al.'s FPST (2002) and Payne's WIT (2001) differ in the stimulus presentation. In fact, whereas in the Payne Task ethnicity cues are presented as prime (e.g. Black or White face) before the object to be categorized and then a response is requested, in the FPST[14] ethnicity cues and objects are presented simultaneously (e.g. armed or unarmed, either Black or White target) and a *shoot-don't shoot* decision is requested.
Moreover, a system of awarding and deducing points is used to reproduce, even feebly, the pay-off matrix (e.g., FA = - 20 pts; Hit = + 10 pts) a decision to shoot could be experienced in such circumstances.
Results in Correll, Park, Judd, & Wittenbrink (2002) showed participants were affected in their reaction times and accuracy by the ethnicity of the target.
Moreover, SDT parameters (***c*** and ***d'***) analysis showed that, although participants' ability to discriminate armed from unarmed targets was not affected by targets' ethnicity, they set a lower decision criterion to shoot Afro-Americans than White targets.
In fact, although participants were quicker and more accurate in shooting Black armed targets than White ones, they were faster and more accurate in responding *don't shoot* when presented with White targets.
Authors found results consistent with the hypothesis that participants used targets' ethnicity to cope with ambiguity in threatening target detection.

[14] See Correll and Judd (2002) for more details.

Correll, Park, Judd, & Wittenbrink (2002) argue that participants used deductive inference in associating the category trait of the target's ethnic group to the target itself.
Without any relation to racist feelings, dislike toward a particular ethnic group or prejudice, participants simply linked, endorsing a stereotype, the concepts of Afro-American and Violent or Dangerous.
Interestingly, Correll, Park, Judd, & Wittenbrink (2002) report that Sagar & Schofield (1980), in their research, found that *both White and African American participants interpreted behaviour as more threatening if it had been performed by an African American target*, supporting the hypothesis that this behaviour reflects *a common belief, or stereotype, that African Americans are more violent than Whites* (Correll, Park, Judd, & Wittenbrink, 2002, p. 1314).
In accordance with Sagar & Schofield (1980), Correll, Park, Judd, & Wittenbrink conclude their study, suggesting that *the Shooter Bias evident in* [their] *videogame might be a consequence of participants using stereotypic associations about African Americans to help interpret ambiguous African American targets* (Correll, Park, Judd, & Wittenbrink, 2002, p. 1323).
After the analysis of a battery of individual difference measures in order to evaluate participants' endorsement of a prejudice against African Americans and their motivation to control it, Correll, Park, Judd, & Wittenbrink suggest that *the magnitude of the bias was related to participants' perceptions of the cultural stereotype about Afro-Americans* and that participants' bias *was not, however, related to either personally endorsed stereotypes or prejudices.* Thus, *White and African Americans display equivalent levels of bias* (Correll, Park, Judd, & Wittenbrink, 2002, p. 1323).

Figure 4. 1 Sample stimuli from Correll et al., (source: Correll, Wittenbrink, Park, Judd, & Sadler, 2008).

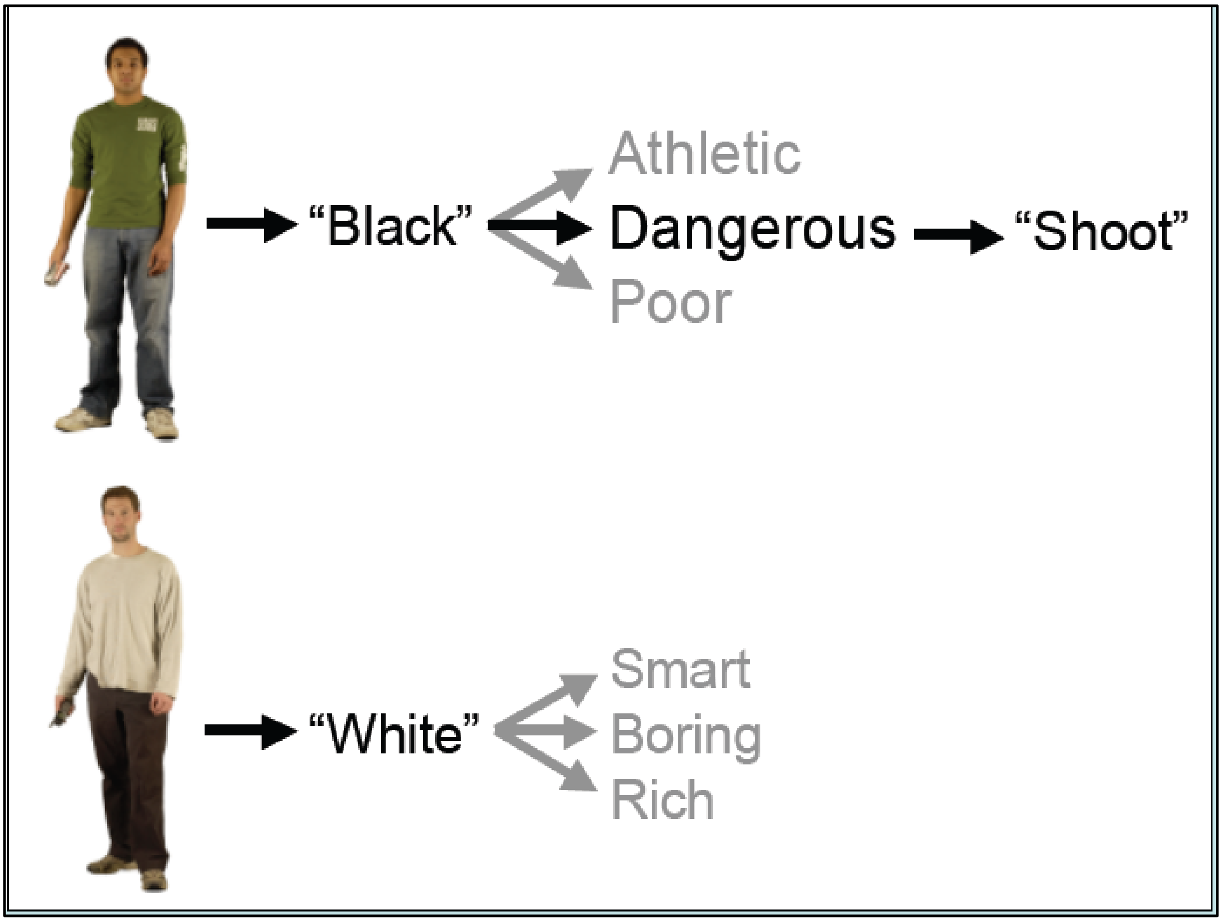

Figure 4. 2 Stereotype activation (source: Correll, Wittenbrink, Park, Judd, & Sadler, 2008).

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Study 3

In this study a FPST similar to the one used in Correll, Park, Judd, & Wittenbrink (2002) and Correll et al. (2007) was used.The aim of the FPST adopted in this study was to simulate a confrontation where a weapon could be one of the objects a person could drop from his pocket.Moreover, a priming paradigm was introduced into this FPST using a sequence of human figures that vary in ethnicity (only for their faces), in their posture, e.g., different relaxed postures first and holding up an object immediately after, and the threat they pose (e.g., holding up a weapon or a tool).

The implemented FPST resulted in a fast sequence of human figure presentation that simulated at first an approach to an unarmed subject that suddenly drops an object either lethal (weapon) or innocuous such a wallet or brush.

Furthermore, as in Studies 1 and 2, IAPS pictures were presented before the FPST to elicit specific emotions and to investigate the effect of affective pictures on this kind of task.

Methods

Participants[15] and design

42 white EU citizens (32F, 10M; Age: M = 26.4; SD = 8.9). The participation in the study was voluntary.

Stimuli (Prime and Target)

184 digitalized photographs of human figures varying in Ethnicity (Black/White/Neutral). Human figures were created with Photoshop in order to build a set of bodies with different postures without any racial cue. To every figure a face was added to the top in order to create a harmonic human figure varying in ethnicity. The Neutral set of people was created by replacing the face with a grey baseball cap.

Prime stimuli included thirty-six human figures (four different relaxed postures), with twelve White faces, twelve Black faces and four Neutral; target stimuli (172) were represented by the same human figures but holding either four weapons or four tools (Left/Right hand).

Stimuli (International Affective Picture System - IAPS; Lang, Bradley, and Cuthbert, 2008)

Two groups of 6 (G1 and G2) and three groups of 4 (G3, G4 and G5) digitalized 20 x 16 cm IAPS pictures were created. Stimuli were selected according to IAPS standard ratings, as reported in Table 4.1, and the groups, homogeneous for Valence and Arousal, named as follows:

a) Group 1 (L_P): Arousal = Low and Affective Valence = Positive
b) Group 2 (H_P): Arousal = High and Affective Valence = Positive
c) Group 3 (H_NG): Arousal = High and Affective Valence = Negative; Type = Generic
d) Group 4 (H_NA): Arousal = High and Affective Valence = Negative; Type = Assault
e) Group 5 (H_NAA): Arousal = High and Affective Valence = Negative; Type = Armed Assault

[15] For this experiment I would like to thank the director of Campus Universitario Ciels (Padova – Italy. http://www.unicriminologia.it/), Simone Borile, his staff, and the students for logistics and participation.

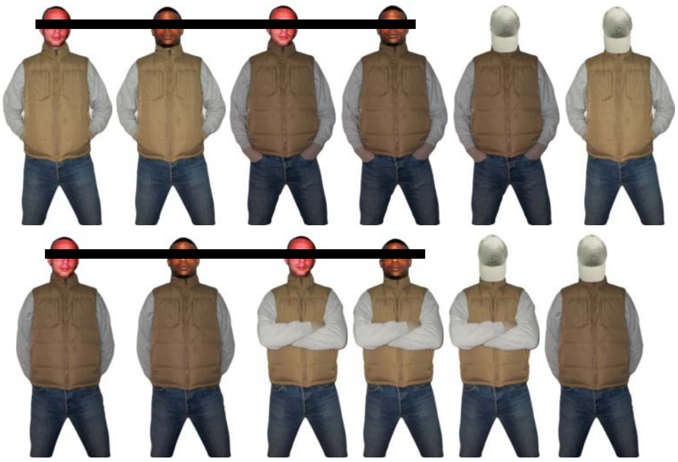

Figure 4. 3 Sample stimuli (relaxed postures).

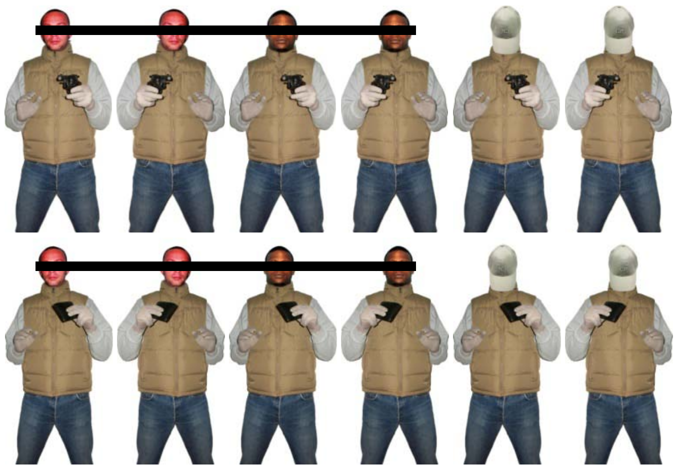

Figure 4. 4 Sample targets (holding up objects).

	(G1)L_P		(G2)H_P		(G3)H_NG		(G3)H_NA		(G4)H_NAA	
	5600		8179		1120		6312		3500	
	5660		8180		1525		6315		3530	
	5830		8185		8480		6360		6313	
	7330		8186		9921		6530		6540	
	7350		8370		----		----		----	
	7508		8400		----		----		----	
	Val	**Aro**	**Val**	**Aro**	**Val**	**Aro**	**Val**	**Aro**	**Val**	**Aro**
M	7.44	5.06	7.17	6.84	3.16	6.56	2.45	6.31	2.04	6.89
SD	1.64	2.52	1.66	2.11	1.79	1.99	1.70	2.30	1.40	2.16

Table 4. 1 IAPS pictures selected Means and SD for Valence and Arousal (Study 3)[16].

[16] *International Affective Picture System:* Male subjects (2005, Picture sets 1-16). International Affective Picture System (IAPS): Technical Manual and Affective Ratings. (Lang, P.J., Bradley, M.M., and Cuthbert, B.N. 2005)

Procedure

Participants were seated 60 cm from a 15 in computer screen (resolution 1280x1024, Ref. T.60 Hertz, Colours 32 bit) and were told that further instructions were available on the screen.

Personal data recording

As in Studies 1 and 2.

First Person Shooting Task (FPST)

Training trials (20)

After the completion of the preliminary phase, participants entered a training phase of 20 trials to familiarize themselves with the task.

All participants were warned they were beginning the experimental phase and informed about the lasting and the different phases of the test.

Participants then started a block of 20 practice trials in which they were presented with a fixation red cross for 500 ms, than a Neutral Prime and after 200 ms this was replaced by the target (armed/not armed).

Participants had to respond pressing a response key to shoot (space bar) and not to shoot (C or M). After 200 ms the object was masked and after 500 ms a "Faster" sign appeared if any response key were pressed. The "Faster" banner was placed in order to hide the object leaving the face visible. Fixation cross and feedbacks were placed at face high.

Participants received a red "Wrong Armed/Not armed target" as negative feedback or a black "OK Armed/Not armed target" as positive feedback that remained on the screen till the next trial was presented, thus the effective deadline was 900 ms after the mask was superimposed on the target.

After 700 ms another trial would start.

The training trials were designed to help participants learn the task and respond within the deadline.

After the SAM page a warning they were entering the test trials and reminding them which the computer keys they had to use to respond were provided by the computer.

Task 1 (90 trials)

Test trials were similar in sequence to practice trials except that participants were presented with test trials in which a prime varying in Ethnicity (Black/White/Neutral) was used and, as in the practice trials, after 200 ms this was replaced by the target (weapon/tool).

IAPS pictures presentation phase 1 and 2 (9 each) before Task 2

Completed Task 1, participants were warned that next they were going to perform a similar task but that it would be anticipated by a picture. Participants were warned to ignore the first picture (IAPS pictures) and to respond to the target.

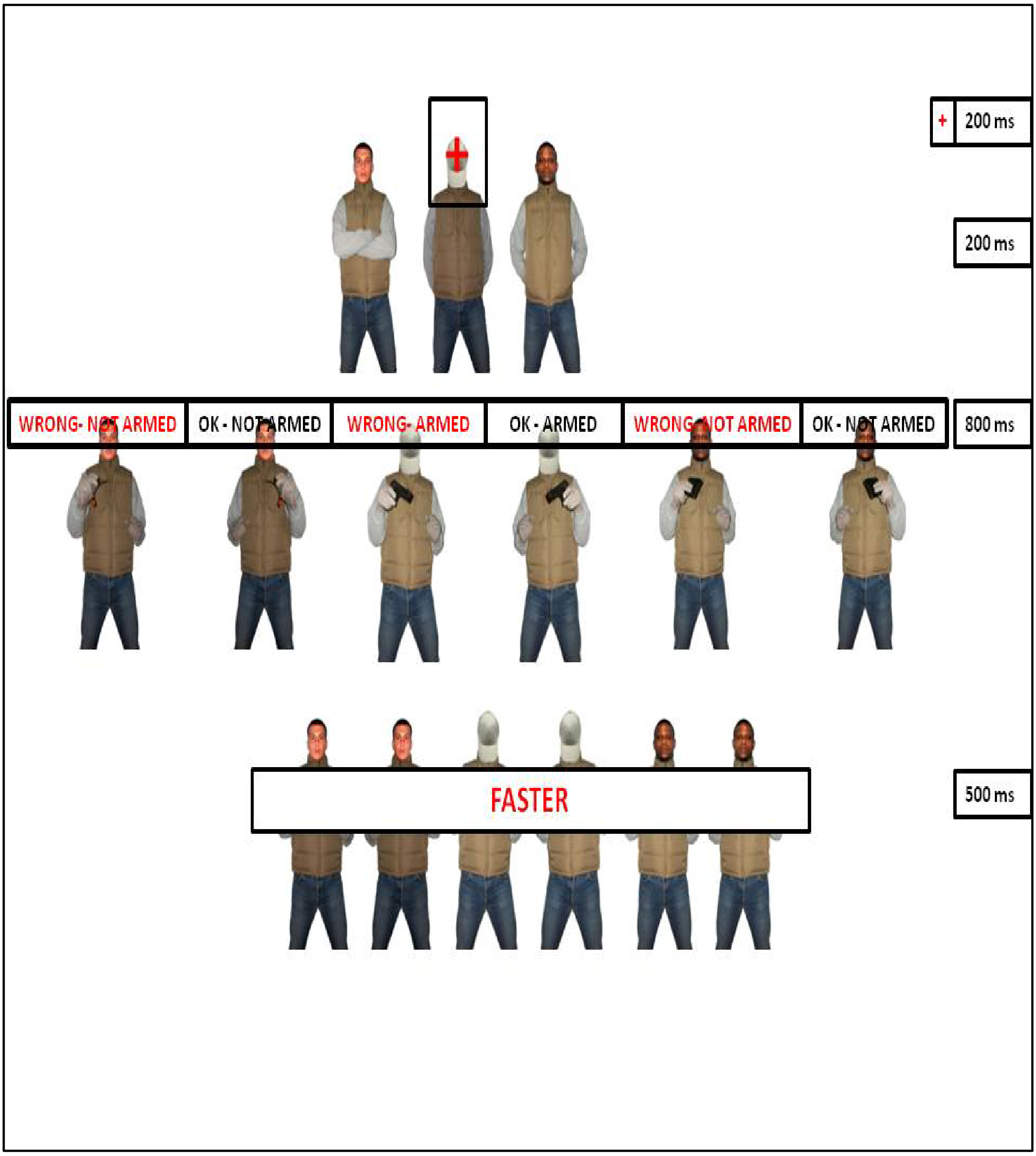

Figure 4. 5 Stimuli presentation and timing.

Moreover, participants were informed they were going to be presented with nine pictures that would be presented before the shooting task and were invited to remember them because they were the signal the task was beginning.

The pictures were presented in two rounds of nine (nine Low Arousal Positive Valence and 9 High Arousal Positive Valence) to participants' full screen size and participants had the opportunity to watch the pictorial stimuli at their own pace as in Study 2.

After the round of IAPS pictures a SAM was administered.

Pictures presented in the re-view sub-phase were used in the following priming task.

Then participants received a warning informing the participant than he/she was entering a new phase of the experiment and reminding them which computer keys they had to use to respond.

IAPS pictures presentation phase 3 (12 each) before Task 3

Completed Task 2, participants were warned as for Task 2, they were entering the third phase similar to the one they had completed.

The pictures for task 3 were presented in one round of twelve (four High Arousal Negative Generic, four High Arousal Negative represented by Assaults, and four High Arousal Negative represented by Armed Assaults) to participants' full screen size, and participants had the opportunity to watch the pictorial stimuli at their own pace as in Study 2.

After the two rounds of IAPS pictures a SAM was administered.

Pictures presented in the re-view sub-phase were used in the following priming task.

Then participants received a warning informing the participant than he/she was entering a new phase of the experiment and reminding them which computer keys they had to use to respond.

Tasks 2 and 3 (216 trials each)

IAPS pictorial stimuli were presented for 400 ms before the shooting task as in Task 1.

Experiment procedure

Altogether, participants had to perform 542 trials, 20 training trials (using only Neutral human figures); 90 trials for Task 1; 216 trials for Task 2; and 216 trials for Task 3.

Reaction times were recorded in milliseconds and considering ***Signal Detection Theory*** (SDT) perceptual sensitivity (***d'***) and response bias (***c***) were computed using Hit and False Alarms rates to measure the effect of Object, Race, Arousal, and IAPS pictures Type on participants' performance.

To summarize, the sequence of the experiment was as follows:

1. Personal data recording (demographics and SAM 1)
2. Training trials
3. Shooting Task (Task 1)
4. Stimuli presentation (Low Arousal Positive Valence)
5. SAM (2)
6. Stimuli presentation (High Arousal Positive Valence)
7. SAM (3)
8. Shooting Task (Task 2).
9. Stimuli presentation (High Arousal Negative Valence: Generic, Assault, Armed Assault)
10. Shooting Task (Task 3)
11. SAM (4)

Analysis found no main effects or interactions involving sex, thus all the following analyses are collapsed over these factors. The main dependent variables included Ethnicity (Black, White, and Neutral), the Type of the target (armed *vs* not armed), Arousal (High *vs* Low), Valence (Positive *vs* Negative), and IAPS pictures Type (generic, assault, armed assault).

Design

The design of the experiment was:

a) For **Task 1**: 3 ETHNICITY (Black, White, and Neutral) x (only for RTs) 2 OBJECT (weapon *vs* tool) or 4 TYPE OF RESPONSE (Hit, CR, Miss, and FA).

b) For **Task 2** (VALENCE = Positive): 2 x AROUSAL (Low and High) x 3 ETHNICITY (Black, White, and Neutral) x (only for RTs) 2 OBJECT (weapon *vs* tool) or 4 TYPE OF RESPONSE (Hit, CR, Miss, and FA).

c) For **Task 3** (AROUSAL = High and VALENCE = Negative) x 3 ITYPE (Generic, Assault, Armed Assault) x 3 ETHNICITY (Black, White, and Neutral) x (only for RTs) 2 OBJECT (weapon *vs* tool) or 4 TYPE OF RESPONSE (Hit, CR, Miss, and FA).

SDT (Hit rate, FA rate, ***c*** and ***d'***) parameters were computed.

Results

Responses given after the timeout for each trial for the three tasks were not recorded and responses given before the presentation of the target were not recorded as “0”; recoded then as system-missing value for the analysis. As a consequence a loss of data of 0.32% for Task 1, 0.11% for Task 2, and 0.06% for Task 3 occurred. Moreover, no subjects with less than 70% of responses recorded (or system-missing value) and 60% of medium latencies as outliers were discharged.

An analysis of RTs on correct responses was computed using only 85% of data for Task 1, 90% for Task 2, and 91% for Task 3.

Latencies were log-transformed then averaged for each condition. Supplemental analyses performed on untransformed data produced very similar results. Results are reported in milliseconds (ms) for reaction times and untransformed for SDT parameters.

[Significance is reported in tables with * for p < .05 and ** for p = < .001]

Task 1 (No IAPS pictures)

Two analyses of variance (ANOVA) were computed for each dependent variable:

1. Ethnicity of the prime (Ethnicity) and Object type of the target (Object);
2. Ethnicity of the prime (Ethnicity) and Type of response (RType - only for RTs).

The design included, respectively, one or two within-subjects factors:

1. Ethnicity (Black, White, and Neutral) for SDT parameters, and Object (weapon and tool) for RTs.
2. Ethnicity (Black, White, and Neutral) for SDT parameters, and (Hit, CR, Miss, FA) for RTs.

Reaction Times (RTs)

As in Correll et al. (2002) the analysis of variance (ANOVA) of the mean reaction times, at first, was performed on correct responses (15% data dropped) treating Ethnicity (Black, White and Neutral) and Object (weapon and tool) as within-subjects factors.

The analysis revealed a significant main effect for Object [$F(1, 41) = 37.549$, $p < .001$, $r = .69$] (see Table 4.2 for Means and S.E. p.111).

The second analysis of variance (ANOVA) for the within-subjects factor RType (Hit, CR, Miss, FA) performed for control trials (Neutral Prime) show participants' RTs significantly differed in relation to the RType they gave [$F(3, 81) = 7.072$, $p < .001$] (see Table 4.3 for Means and S.E.).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RType on: Hit responses as compared to CR [$F(1, 27) = 25.427$, $p < .001$], with a large effect size ($r = .70$); CR responses as compared to Miss [$F(1, 27) = 8.785$, $p < .01$] with a medium effect size ($r = .49$). No significant difference was found on Miss responses as compared to FA [$F(1, 27) = 0.50$, p = n.s.].

As for the analysis performed only for control trials (Neutral Prime), results of the analysis of variance (ANOVA) for the two within-subjects factors Ethnicity (Black, White, and Neutral) and RType (Hit, CR, Miss, FA) show participants' RTs significantly differed in relation to the RType they gave [$F(3, 48) = 26.416$, $p < .001$] (see Table 4.4 for Means and S.E.).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RType on: Hit responses as compared to CR [$F(1, 16) = 15.518$, $p = .001$], with a large effect size ($r = .70$); CR responses as compared to Miss [$F(1, 16) = 55.363$, $p < .001$] with a large effect size ($r = .88$); Miss as compared to FA was found [$F(1, 16) = 11.986$, $p < .005$] with a large effect size ($r = .65$).

No other significant main effects or interactions were found.

Tables for RTs: Task 1, Study 3 (Means and S.E.)

OBJECT	MEAN (ms)	S.E.
Weapon	423** r = .69	9.455
Tool	475	10.768

Table 4. 2 Object: RT Means and S.E. for correct responses (Hit and CR, Task 1).

RTYPE	MEAN (ms)	S.E.
HIT	410** r = .70	10.222
CR	464* r = .49	13.364
MISS	395	21.745
FA	399	14.176

Table 4. 3 Response Type: RT Means and S.E. for control trials (Task 1).

RTYPE	MEAN (ms)	S.E.
HIT	400** r = .70	14.339
CR	463** r = .88	19.006
MISS	356* r = .65	12.845
FA	386	15.030

Table 4. 4 Response Type: RT Means and S.E. for complete data (Task 1).

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Discussion (Study 3 - Task 1)

Results of the analysis performed on RTs for correct responses replicated findings in previous studies (Study 1 Task 1; Correll et al., 2002, 2007).

Subjects shot faster armed targets than unarmed ones. In contrast with common findings (Correll et al. 2002, 2007; Payne 2001), in this task no racial bias was displayed.

Moreover, as for Task 1 of Study 1, a significant difference was found in type of responses: correct responses (Hit and CR) were significantly slower than wrong responses (Miss and FA). Moreover, confirming the model presented for Task 1 of Study 1 (page 113), armed targets were correctly shot faster than unarmed ones.

Whereas the two paradigms, the WIT and the FPST, implemented for this research seem to result in the same findings, a significant difference was found in RTs between Miss and FA. In fact, participants responded faster when they misperceived a weapon as a tool (FA) than when they wrongly “saw” a weapon.

This result seems to represents a violation to the Prediction-Confirmation Hypothesis proposed and its eventuality will be analysed more specifically.

Task 2 (Valence = Positive)

Two analyses of variance (ANOVA) were computed for each dependent variable:

1. Arousal of the IAPS pictures (Arousal), Ethnicity, and the Object (only for RTs).
2. Arousal of the IAPS pictures (Arousal), Ethnicity, and the RType (only for RTs).

The design included two and three within-subjects factors:

1. Arousal (Low vs High), Ethnicity (Black, White, and Neutral) for SDT parameters and Object (weapon and tool) for RTs.
2. Arousal (Low vs High), Ethnicity (Black, White, and Neutral) for SDT parameters and RType (Hit, CR, Miss, and FA) for RTs.

Reaction Times

The analysis of variance (ANOVA) of the mean reaction times as in Correll et al. (2002), performed on correct responses (10% data dropped) treating Arousal (Low and High), Ethnicity (Black, White and Neutral) and Object (weapon and tool) as within-subjects factors revealed a significant main effect for Object [F (1, 41) = 11.254, p < .005, r = .46] (see Table 4.5 for Means and S.E., p. 115).

Moreover, the analysis revealed a significant main effect for Ethnicity [F (2, 82) = 3.537, p < .05] (see Table 4.6 for Means and S.E., p. 115).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RTs on Black targets as compared to Neutral [F (1, 41) = 4.474, p < .05], with a medium effect size (r = .31); on White targets as compared to Neutral [F (1, 41) = 4.374, p < .05] with a medium effect size (r = .31).

Moreover, results show participants' RTs were affected by the interaction between Arousal, Ethnicity, and Object [F (2, 82) = 6.596, p = .01] (see Table 4.7 for Means and S.E., p. 115).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RTs when Low Arousal Negative IAPS pictures were presented before Black targets as compared to Neutral on weapon [F (1, 41) = 4.474, p < .05], with a medium effect size (r = .31); on White targets as compared to Neutral [F (1, 41) = 6.002, p < .05] with a medium effect size (r = .36).

Results of the second analysis of variance (ANOVA) for the two within-subjects factors Arousal (Low and High) and RType (Hit, CR, Miss, FA) of control trials (Neutral Prime) show participants' RTs significantly differed in relation to the RType they gave [F (3, 51) = 7.964, p < .001] (see Table 4.8 for Means and S.E., p. 115).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RType on Miss responses as compared to FA [F (1, 17) = 6.189, p< .05], with a large effect size (r = .52).

No significant differences were found on: Hit responses as compared to CR [f (1, 17) = .423, p = n.s.]; CR responses as compared to Miss [F (1, 17) = 2.214, p = n.s.] with a medium effect size (r = .42).

No other significant main effects or interactions were found.

Tables for RTs: Task 2, Study 3 (Means and S.E)

OBJECT	MEAN (ms)	S.E.
Weapon	447* r = .46	7.428
Tool	430	6.365

Table 4. 5 Object: RT Means and S.E. for correct responses (Hit and CR, Task 2).

ETHNICITY	MEAN (ms)	S.E.
Black	436* r = .31	6.641
White	435* r = .31	7.445
Neutral	445	6.498

Table 4. 6 Ethnicity: RT Means and S.E. (Task 2).

AROUSAL	ETHNICITY	OBJECT	MEAN (ms)	S. E.
Low	Black	Weapon	450* r = .31	7.547
		Tool	414	8.393
	White	Weapon	439* r = .36	8.682
		Tool	426	9.225
	Neutral	Weapon	457	9.804
		Tool	433	10.189
High	Black	Weapon	430	9.414
		Tool	450	8.212
	White	Weapon	451	9.215
		Tool	423	7.635
	Neutral	Weapon	456	9.489
		Tool	434	13.636

Table 4. 7 Arousal*Ethnicity*Object: RT Means and S.E. for the interaction (Task 2).

RTYPE	MEAN (ms)	S.E.
Hit	443	17.583
CR	427	15.285
Miss	390* r = .52	19.737
FA	359	12.181

Table 4. 8 RT Means and S.E. for control trials (Task 2).

SDT Parameters

Results of the analysis of variance (ANOVA) for the two within-subjects factors Arousal (Low *vs* High) and Ethnicity (Black, White, and Neutral) showed no significant main effects or interactions on participants' Hit and FA rates.

*Criterion (**c**)*

Results of the analysis of variance (ANOVA) for the two within-subjects factors Arousal (Low *vs* High) and Ethnicity (Black, White, and Neutral) show participants' *criterion* (***c***) was affected by Ethnicity [F (2, 82) = 3.147, p < .05] (see Table 4.9 for Means and S.E.).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of *criterion* (***c***) values on White targets as compared to Neutral [F (1, 41) = 7.262, p < .05], with a medium effect size (r = .39); whereas no significant difference was found on Black targets as compared to Neutral [F (1, 41) = 1.039, p = n.s.]

No other significant main effects or interactions were found.

ETHNICITY	MEAN	S.E.
Black	.008	.025
White	-.049* r = .39	.030
Neutral	.047	.031

Table 4. 9 Ethnicity: *c* values Means and S.E. (Task 2).

Discussion (Study 3 - Task 2)

As for previous studies (Studies 1 and 2), IAPS picture presentation (in this task positive valenced either high or low arousal level) before the FPST pushed participants to be slower in shooting correctly armed targets as compared to unarmed ones, in contrast with control condition (No IAPS picture).

Interestingly, whereas no racial bias was displayed, a significant difference was found in Ethnicity. In fact, participants responded faster when presented with human faces, either Black or White, than when presented with Neutral targets.

Whereas unarmed targets were correctly identified faster, only one condition contrasted this tendency, displaying a racial bias in RTs: High Arousal Positive valenced IAPS picture presentation before Black armed targets as compared to unarmed ones. In fact, only in this condition did participants shot correctly armed Black targets faster than unarmed ones and, in contrast, were significantly slower in shooting armed Black targets than unarmed ones when presented with Low Arousal Positive valenced IAPS pictures.

In the FPST, arousal interacted selectively with ethnicity and type of target. In fact, whereas positive IAPS pictures with low levels of arousal did not change the tendency, participants displayed in shooting the three different targets (Black, White and Neutral), positive valenced IAPS pictures with high levels of arousal made participants faster in shooting Black armed targets than unarmed ones.

It seems that the effect of positivity vanishes when high arousal affect state is stimulated before confronting Black armed targets.

Results give support to the hypothesis proposed by (Zillman, 1971) that *arousal cues are generally non-specific and are easily transferred from one arousing source to another*
(cfr. Page 51)

It is interesting here to note that *criterion* (***c***) values analysis showed participants were biased by the ethnicity of the target. In fact, surprisingly, the criterion of the decision to shoot White targets was significantly lower, meaning that participants tended to shoot more White targets than either Blacks or Neutrals.

Positive valenced pictures, either high or low arousal, seem to have had little effect on participants' performance.

It remains to be explained the reason why a significant difference was found in the analysis of RTs for control trials (Neutral stimuli, see figures 4.3 and 4.5, p. 106) within wrong responses (Miss = 390 ms; FA = 359 ms).

Task 3 (Arousal = High; Valence = Negative)

An analysis of variance (ANOVA) was computed for each dependent variable as for Task 1:

1. Type of the IAPS pictures (IType), Ethnicity, and the Object (only for RTs).
2. Type of the IAPS pictures (IType), Ethnicity, and the RType (only for RTs).
3.

The design included two or three within-subjects factors:

1. Type (Generic, Assault, Armed Assault), Ethnicity (Black, White, and Neutral) for SDT parameters and Object (weapon and tool) for RTs.
2. Type (Generic, Assault, Armed Assault), Ethnicity (Black, White, and Neutral) for SDT parameters and RType (Hit, CR, Miss, and FA) for RTs.

<u>*Reaction Times*</u>

The analysis of variance (ANOVA) of the mean reaction times as in Correll et al. (2002), performed on correct responses (13% data dropped) treating Arousal (Low and High), Ethnicity (Black, White and Neutral) and Object (weapon and tool) as within-subjects factors revealed a significant main effect for Object [$F(1, 41) = 10.494$, $p < .005$, $r = .45$] (see Table 4.10 for Means and S.E., p. 119).

Moreover, the analysis revealed a significant main effect for Ethnicity [$F(2, 82) = 4.181$, $p<.05$] (see Table 4.11 for Means and S.E., p. 119).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RTs on Black targets as compared to Neutral [$F(1, 41) = 5.665$, $p < .05$], with a medium effect size ($r = .35$); on White targets as compared to Neutral [$F(1, 41) = 4.384$, $p < .05$] with a medium effect size ($r = .31$).

Furthermore, the analysis revealed a significant main effect for ITYPE [$F(2, 82) = 4.626$, $p<.05$] (see Table 4.12 for Means and S.E., p. 119).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RTs on Armed Assault as compared to Generic [$F(1, 41) = 9.797$, $p < .01$], with a medium effect size ($r = .44$); on assault as compared to Generic [$F(1, 41) = 4.927$, $p < .05$], with a medium effect size ($r = .33$).

No main effects or significant interaction were found on participants' RTs for the second analysis.

Tables for RTs: Task 3, Study 3 (Means and S.E)

OBJECT	MEAN (ms)	S.E.
Weapon	451* r = .45	6.058
Tool	433	6.428

Table 4. 10 Object: RT Means and S.E. for correct responses (Hit and CR, Task 3).

ETHNICITY	MEAN (ms)	S.E.
Black	439* r = .35	5.580
White	438* r = .31	5.710
Neutral	448	6.745

Table 4. 11 Ethnicity: RT Means and S.E. (Task 3).

ITYPE	MEAN (ms)	S.E.
Armed Assault	446 * r = .44	6.595
Assault	443* r = .33	5.606
Generic	437	5.467

Table 4. 12 IAPS picture type presented before the FPST: RT Means and S.E. (Task 3).

SDT Parameters

Results of the analysis of variance (ANOVA) for the one within-subjects factor IType (Generic, Assault, Armed Assault) for control trials (Neutral Prime) show participants' HRate were not affected by the IType [F (2, 82) = 1.417, p = n.s.] (see Table 4.13 for Means and S.E., p. 121).

Results of the same analysis for FARates showed participants' FARates for control trials (Neutral Prime) didn't differ in relation to the IType [F (2, 82) = .048, p = n.s.] (see Table 4.14 for Means and S.E., p. 121).

The analysis of variance (ANOVA) for the two within-subjects factors IType (Generic, Assault, Armed Assault) and Ethnicity (Black, White, and Neutral) show participants' HRate was affected by the interaction between IType and Ethnicity [F (4, 164) = 2.514, p < .05] (see Table 4.15 for Means and S.E., p. 121 and Graphic 4.1 p. 122).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Armed Assault IAPS pictures were presented before White Prime compared to Generic IAPS pictures and Neutral Prime in HRates [F (1,41) = 4.754, p< .05], with a medium effect size (r = .32).

Results of the same analysis for FARates showed participants' FARates differ in relation to the Ethnicity [F (2, 82) = 5.681, p = .005] (see Table 4.16 for Means and S.E., p. 122).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of FARates on Black targets as compared to Neutral [F (1, 41) = 13.624, p = .001], with a large effect size (r = .50); whereas no significant difference was found on White targets as compared to Neutral [F (1, 41) = .134, p = n.s.]

No other significant main effects or interactions were found.

Tables for Hit & FA: Task 3, Study 3 (Means and S.E)

ITYPE	MEAN	S.E.
Armed Assault	.890	.013
Assault	.863	.017
Generic	.883	.012

Table 4. 13 IAPS picture type presented before the FPST: Hit Rate Means and S.E. (Task 3).

ITYPE	MEAN	S.E.
Armed Assault	.137	.014
Assault	.132	.015
Generic	.136	.017

Table 4. 14 IAPS picture type presented before the FPST: FA Rate Means and S.E. (Task 3).

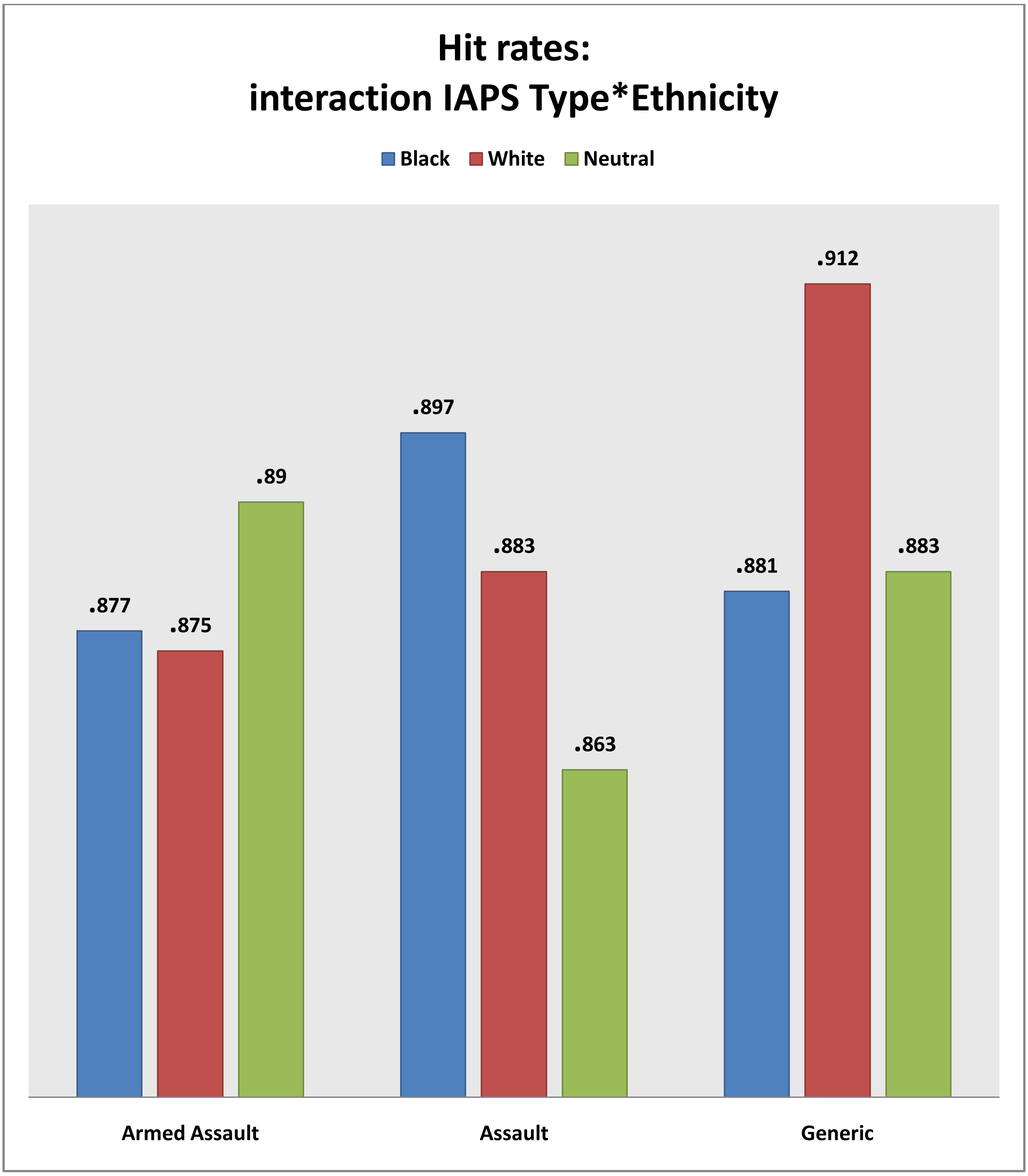
ITYPE	ETHNICITY	MEAN	S.E.
Armed Assault	Black	.877	.015
	White	.875* r = .32	.016
	Neutral	.890	.013
Assault	Black	.897	.012
	White	.883	.013
	Neutral	.863	.017
Generic	Black	.881	.014
	White	.912	.009
	Neutral	.883	.012

Table 4. 15 FA Means and S.E. for the interaction between IType and Ethnicity (Task 3).

Tables and Graphic for Hit & FA: Task 3, Study 3 (Means and S.E)

ETHNICITY	MEAN	S.E.
Black	.107** r = .50	.010
White	.131	.012
Neutral	.135	.011

Table 4. 16 Ethnicity: FA Rate Means and S.E. (Task 3).



Graphic 4.1 Hit rates: Graph of the interaction between IType and Ethnicity (Study 3 Task 3).

*Criterion (**c**)*

Results of the analysis of variance (ANOVA) for the one within-subjects factor IType (Generic, Assault, Armed Assault) for Neutral trials show participants' *criterion* (***c***) values were not affected by the IType [F (2, 82) = .875, p = n.s.] (see Table 4.17 for Means and S.E.).

Results of the analysis of variance (ANOVA) for the two within-subjects factors IType (Generic, Assault, Armed Assault) and Ethnicity (Black, White, and Neutral) show participants' *criterion* (***c***) was affected by the interaction between IType and Ethnicity [F (4, 164) = 3.059, p = .05] (see Table 4.18 for Means and S.E. and Graphic 4.2 p. 124).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference when Assault IAPS pictures were presented before Black Prime compared to Generic IAPS pictures and Neutral Prime in *criterion* (***c***) [F (1,41) = 4.160, p< .05], with a medium effect size (r = .30); whereas no significant difference was found on White targets as compared to Neutral [F (1, 41) = 1.061, p = n.s.].

No other significant main effects or interactions were found.

Tables for c values: Task 3, Study 3 (Means and S.E)

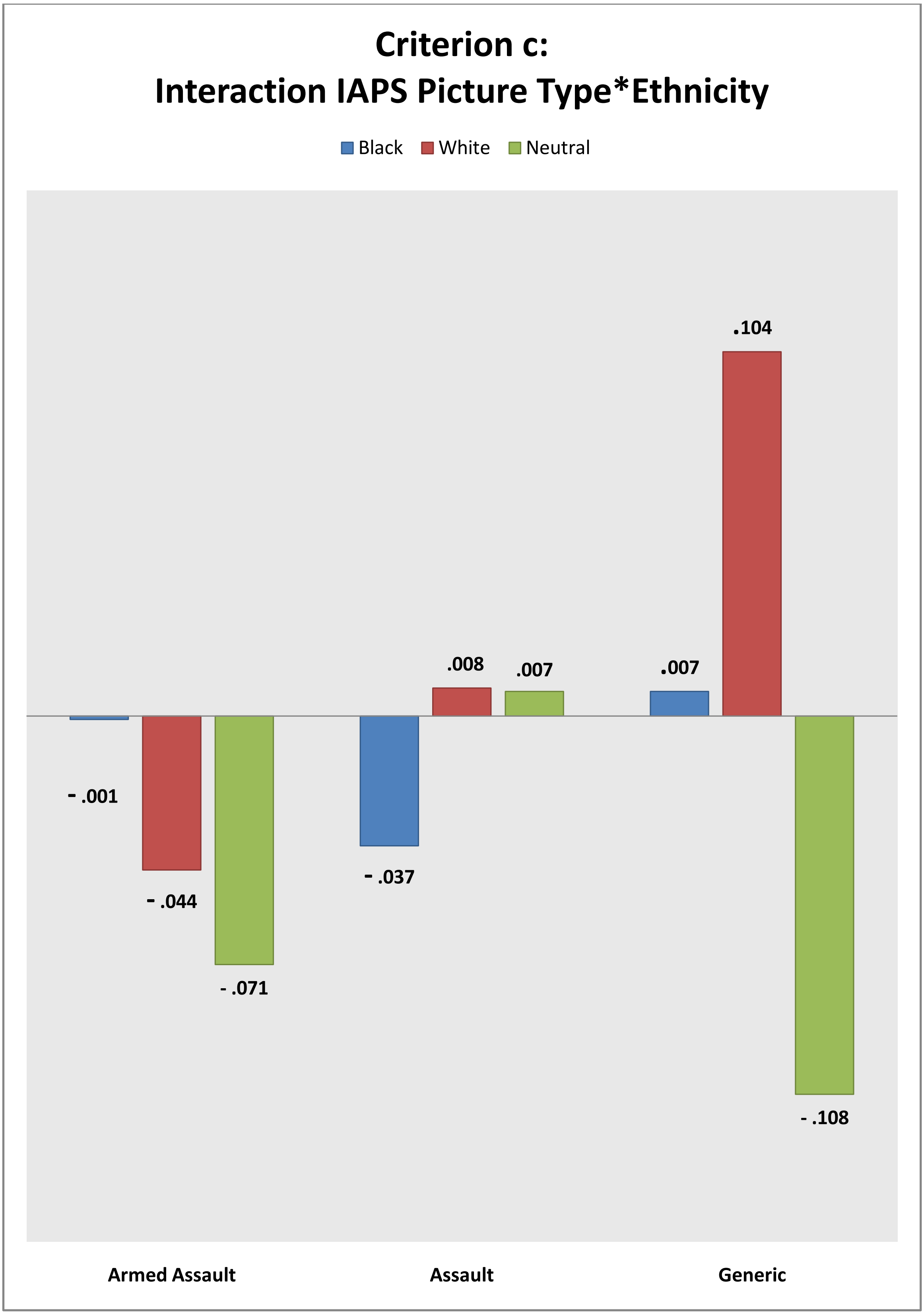
ITYPE	MEAN	S.E.
Armed Assault	-.071	.039
Assault	.007	.044
Generic	-.027	.034

Table 4. 17 *c* value Means and S.E. for the control trials and Type of IAPS pictures presented before the Evaluative Priming Task (Task 3).

ITYPE	ETHNICITY	MEAN	S.E.
Armed Assault	Black	-.001	.046
	White	-.044	.047
	Neutral	-.071	.039
Assault	Black	-.037* r = .30	.037
	White	.008	.045
	Neutral	.007	.044
Generic	Black	.104	.033
	White	-.108	.040
	Neutral	-.027	.034

Table 4. 18 IType*Ethnicity: *c* values Means and S.E. for the interaction (Task 3).

Graphic for criterion c values: Task 3, Study 3.



Graphic 4.2 *Criterion* (*c*): Graph of the interaction between IType and Ethnicity (Study 3 Task 3).

Discussion (Study 3 - Task 3)

As for previous studies (Studies 1 and 2), IAPS picture presentation (in this task negative valenced high arousal level, generic or assault either armed or unarmed) before the FPST pushed participants to be slower in shooting correctly armed targets as compared to unarmed ones, in contrast with the control condition (No IAPS picture).

Results for RTs analyses were very similar to the results of Task 2 of this study despite the fact that no racial bias was displayed on RTs and that assaults, either armed or unarmed, IAPS pictures in general negatively affected RTs (generic = 437 ms; assault = 443 ms; assault armed = 446 ms).

Furthermore, results support the hypothesis that arousing negative affect states make ethnical cues and stereotypes less salient and level reaction times accordingly.

Results for the control condition (Neutral targets) show that the type of IAPS pictures (negative valenced and high level of arousal for this task) affected significantly Hit rates and, interestingly, the lowest rate is represented by the condition in which assault IAPS pictures were presented before the FPST as compared either to armed assault and generic.

Furthermore, the same tendency was shown for FA rates even if differences are really slight.

It must to be noted that in this task Black armed targets were shot wrongly less than Whites and Neutrals.

A deeper analysis revealed that armed assault pictures lowered and levelled values as compared to Neutral targets; assault enhanced hit rates for Black, whereas generic type of IAPS pictures enhanced hit rates for White targets.

Results of the analysis performed on *criterion* (***c***) values, support the hypothesis that, in general, Armed Assault IAPS pictures favour the tendency to shoot, whereas Assault type has little affect on shooting behaviour. Moreover, Generic IAPS pictures only slightly affect the tendency to shoot.

An explanation of Hit and FA rates and *criterion* (***c***) values, could be found in the hypothesis that, when a weapon is present in the stimuli (environment), the eventuality of a shooting reaction could became more salient, whereas when it is clear that a weapon is not present this eventuality is discharged. When information of weapons is not present (either their presence or absence), a higher level of vigilance could be kept as compared to no weapon condition.

Moreover, *criterion* (***c***) analysis results show that racial bias is sensitive to the type of IAPS pictures presented before the FPST, highlighting the fact that when a racial bias is displayed it interacts with other stimuli differently, showing his weakness.

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General Discussion (Study 3)

The aim of Study 3 was to collect data on Italians in order to verify if the same pattern of researchers' results in this domain could be generalised for ethnical groups where immigration histories and minority groups are different.

In order to simulate a confrontation where a weapon could be one of the objects a person might drop from his pocket, a FPST similar to the one used in Correll, Park, Judd, & Wittenbrink (2002) and Correll et al. (2007) was used. However, a priming paradigm was introduced using a sequence of human figures that varied in ethnicity, in their posture, and the threat they posed, resulting in a fast sequence of human figure presentation that simulated at first an approach to an unarmed subject who then suddenly takes out an object either lethal or innocuous.

Furthermore, as in previous studies, IAPS pictures were presented before the FPST to elicit specific emotions and to investigate the effect of affective pictures on this kind of task.

In order to address issues not clarified in the previous studies, in this study IAPS pictures were differentiated to investigate if arousing positive valenced pictures eventually have different effects as compared to non-arousing pictures, and if diverse types of arousing negative pictures influence differently perception and attention.

Results for the non-IAPS picture control condition partially replicated findings from the literature of reference (Correll, Park, Judd, & Wittenbrink, 2002; Correll et al., 2007) and were very similar to results obtained with the WIT used in the previous studies presented for this research and from Payne, Lambert, & Jacoby (2002) and Payne, Shimizu, & Jacoby (2005). In fact, in the control condition, participants displayed no racial bias and consistently had shifted their attention toward armed targets.

It is interesting to note that for the control condition (non-IAPS picture) a difference was found in RTs within responses where objects were misperceived. In fact, participants showed they were faster in misperceiving a tool as a weapon compared to the opposite condition.

As for the WIT, even though it is difficult to determine if participants responded according to what they "saw or believed they saw", their anticipation in seeing guns, because armed targets were the most relevant category in the task, was extended to faster probability-based responses with the effect of predicting more weapons (armed targets) than tools (un-armed targets) resulting faster but less efficient (shorter latencies for FA responses).

It could be that since the task was more naturalistic than the simple task of categorising objects, participants were more motivated in detecting armed targets and altered the threshold at which weapons would be detected as well as predicted. As for the weapon-weapon association this resulted faster than weapon-no weapon comparison and the armed versus un-armed guess was more adopted, resulting in shorter latencies without increasing their efficiency.

As for previous studies, pictorial stimuli presented before the main task had a dramatic effect on racial bias and object categorization and made ethnicity more salient whereas no racial bias was displayed. That is, a difference was found either for Blacks or Whites as compared to Neutrals.

Results of Study 3 demonstrate how arousal and valence interact differently with ethnicity,

supporting the hypothesis that arousing cues could be transferred from one source to another, not taking into account the valence.
In fact, from one point of view, low arousing positive valenced IAPS pictures made participants "un-armed" target-oriented (visually tuned in), and extended this tendency to misperceptions of weapons as tools without any ethnical orientation; conversely, high arousing stimuli, even if positive, visually tuned participants to being more aware of (thus more ready for) armed Black targets.
Another variable that affected the tendency to shoot and modulated associations is the content of the stimuli.
In fact, armed assault pictures lowered the level of FA rate values for Blacks as compared to Neutral targets, assault enhanced Hit rates for Blacks, whereas generic type of IAPS pictures enhanced Hit rates for White targets. Moreover, in general, Armed Assault IAPS pictures favoured the tendency to shoot, whereas Assault type had little affect on shooting behaviour and Generic IAPS pictures only slightly affected the tendency to shoot.
I argue that when a weapon was present in the stimuli (environment) the eventuality of a shooting reaction become more salient, thus, attention shifting toward weapons was enhanced, whereas when a weapon was not present, a shooting reaction was suppressed. When information of weapons was not clearly present and its absence was not definitively excluded, a higher level of awareness was kept, in order to detect the eventual presence of a weapon and it resulted in a higher level of vigilance as compared to a non-weapon condition.
Finally, it is interesting to note that racial bias was sensitive to the content of the stimuli present in the environment (IAPS pictures) supporting the hypothesis that associations between social categories, concepts, and affective states influence visual processing mechanism.
Real-world objects perception and face attendance are fundamental aspects of vision and information extracted by the environment affect personal mood state and, thus, visual tuning and information processing. Mistakes, or misperceptions, and the way perceivers structure visual stimuli are directed by associations (often automatic) that are influenced by personal affective state.
The last issue I will address will be whether the same pattern of response bias would be displayed by Italian police officers.

Study 4 (Police officers in action)

Correll, Park, Judd, & Wittenbrink conclude their study, writing: *Though these studies suggest that bias in the decision to shoot may be widespread, it is not clear that Shooter Bias actually exists among police officers* (Correll, Park, Judd, & Wittenbrink, 2002, p. 1328).
Later, Plant, Peruche, & Butz (2005) tested 50 certified sworn law-enforcement personnel with a computer simulation similar to Correll et al.'s FPST in order to address the question.
Results confirmed that *officers were initially more likely to mistakenly shoot unarmed Black suspects than unarmed White suspects* (Plant, Peruche, & Butz, 2005, p. 182).
Intriguingly, although the racial bias was found in police officers' responses, it was eliminated with the progress of the computer simulation.
Thus, racial bias does not seem inevitable and may be eliminated with exposure to the task (Plant & Peruche, 2005).
Correll et al. (2007), were able to test with their FPST 124 Denver police officers, 113 US National police officers, and 135 Civilians reporting results in their paper titled *Across the Thin Blue Line: Police Officers and Racial Bias in the decision to shoot* (Correll et al., 2007).
Correll et al.'s research found differences between police personnel and community members in several critical variables (Correll et al., 2007).
In fact, encouragingly, police officers outperformed civilians showing their better ability in detecting weapons and efficiency in responding faster correctly.
Moreover, police officers showed they had higher values of *criterion* (***c***) meaning they were less prone to shooting.
Whereas, no minimal bias in the SDT analysis was shown by police officers, their latencies displayed a robust racial bias in their *shoot/don't shoot* decisions.
Thus, whereas targets' ethnicity did not affect their ultimate decision, it affected their reaction times showing that, like other participants, police officers (and expert students) process racial information and access relevant stereotypes but they have the ability to overcome their interference in final decisions (Correll, 2008).
Correll et al.'s findings, whereas resulting consistent with other studies that found police officers are faster in giving their attention to Black targets (Eberhardt, Goff, Purdie, & Davies, 2004), are not consistent with other research showing police officers display the racial bias in the SDT analysis (Plant, Peruche, & Butz, 2005).
According to Sim & Correll (2009) what helps in overcoming the influence of prevalent cultural stereotypes on the decision to shoot in police officers and expert students is training.
Possibly, training may improve object-based judgements or, promoting cognitive control, may reduce or eliminate the influence of activated stereotypes promoting the execution of more controlled responses according to relevant or irrelevant cues (Sim & Correll, 2009).

Methods

Participants[17] and design
53 White police officers (45M, 8F; Age: M = 39.2; SD = 5.55). The participation in the study was voluntary.

Stimuli (Prime and Target)
As in Study 3.

Stimuli (International Affective Picture System - IAPS; Lang, Bradley, and Cuthbert, 2008)
As in Study 3.

Personal data recording
As in Study 1, 2, and 3.

First Person Shooting Task (FPST) (as Study 3)
Training = 20 trials; Task 1 = 90 trials; IAPS pictures presentation phase 1 and 2 (9 each) before Task 2; IAPS pictures presentation phase 3 (12 each) before Task 3; Task 2 and 3 = 216 trials each.

Procedure
As Study 3.

Design
The design of the experiment was (as Study 3):

a) For **Task 1**: 3 ETHNICITY (Black, White, and Neutral) x (only for RTs) 2 OBJECT (weapon *vs* tool) or 4 TYPE OF RESPONSE (Hit, CR, Miss, and FA).
b) For **Task 2** (VALENCE = Positive): 2 AROUSAL (Low and High) x 3 ETHNICITY (Black, White, and Neutral) x (only for RTs) 2 OBJECT (weapon *vs* tool) or 4 TYPE OF RESPONSE (Hit, CR, Miss, and FA).
c) For **Task 3** (AROUSAL = High and VALENCE = Negative) 3 ITYPE (Generic, Assault, Armed Assault) x 3 ETHNICITY (Black, White, and Neutral) x (only for RTs) 2 OBJECT (weapon *vs* tool) or 4 TYPE OF RESPONSE (Hit, CR, Miss, and FA).

SDT (Hit rate, FA rate, ***c*** and ***d'***) parameters were computed.

Results
Responses given after the timeout for each trial for the three tasks were not recorded and responses given before the presentation of the target as were recorded "0"; recoded then as system-missing value for the analysis. As result a loss less than 0.01 % of data was recorded.
Moreover, no subjects with less than 70% of responses recorded (or system-missing value) and 60% of medium latencies as outliers were discharged.

[17] For this study the author would like to thank Tiziana Labellarte for her help in collecting subjects for the experiment.

Analysis of RTs on correct responses was computed using only 87% of data for Task 1, 91% for Task 2, and 92% for Task 3.
Latencies were log-transformed then averaged for each condition. Supplemental analyses performed on untransformed data produced very similar results. RTs were reported in *ms*.

[Significance is reported in tables with * for p < .05 and ** for p = < .001]

Task 1 (No IAPS pictures)
Two analysis of variance (ANOVA) were computed for each dependent variable:

1. Ethnicity of the prime (Ethnicity) and Type of object held up by the target (Object, only for RTs) for corrected responses;
2. Ethnicity of the prime (Ethnicity) and Type of response (RType, only for RTs) for all the responses.

The design included, respectively, one or two within-subjects factors:

1. Ethnicity (Black, White, and Neutral) for SDT parameters, and Object (weapon and tool) for RTs.
2. Ethnicity (Black, White, and Neutral) for SDT parameters, and (Hit, CR, Miss, FA) for RTs.

Reaction Times (RTs)
As in Correll et al. (2002) the analysis of variance (ANOVA) of the mean reaction times, at first, was performed on correct responses (13% data dropped) treating Ethnicity (Black, White and Neutral) and Object (weapon and tool) as within-subjects factors.
The analysis revealed a significant main effect for Object [F (1, 52) = 100.414, p < .001, r = .81] (see Table 4.19 for Means and S.E., p. 132).
The second analysis of variance (ANOVA) for the two within-subjects factors Ethnicity (Black, White, and Neutral) and RType (Hit, CR, Miss, FA) performed for control trials (Neutral Prime) shows participants' RTs significantly differed in relation to the RType they gave [F (3, 102) = 31.124, p < .001] (see Table 4.20 for Means and S.E., p. 132).
Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RType on: Hit responses as compared to CR [F (1, 34) = 49.475, p< .001], with a large effect size (r = .77); CR responses as compared to Miss [F (1, 34) = 126.757, p < .001] with a large effect size (r = .89).
No significant difference of RType was found on Miss responses as compared to FA [F (1, 34) = 3.911, p = n.s.].
As for the analysis performed only for control trials (Neutral Prime), results of the analysis of variance (ANOVA) for the two within-subjects factors Ethnicity (Black, White, and Neutral) and RType (Hit, CR, Miss, FA) show participants' RTs significantly differed in relation to the RType they gave [F (3, 57) = 35.673, p < .001] (see Table 4.21 for Means and S.E., p. 132).
Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RType on: Hit responses as compared to CR [F (1, 19) = 31.104, p< .001], with a large effect size (r = .79); CR responses as compared to Miss [F (1, 19) = 120.393, p < .001] with a large effect size (r = .93); Miss as compared to FA [F (1, 19) = 6.796, p < .05], with a large effect size (r = .51).

Tables for RTs: Task 1, Study 4 (Means and S.E.)

OBJECT	MEAN (ms)	S.E.
Weapon	445** r = .81	7.828
Tool	497	7.641

Table 4. 19 Object: RT Means and S.E. for correct responses (Hit and CR, Task 1).

RTYPE	MEAN (ms)	S.E.
HIT	439** r = .77	9.466
CR	498** r = .89	10.389
MISS	495	10.557
FA	422	13.114

Table 4. 20 RT Means and S.E. for control trials (Task 1).

RTYPE	MEAN (ms)	S.E.
HIT	427** r = .79	12.660
CR	489** r = .93	13.830
MISS	485* r = .51	12.194
FA	415	15.156

Table 4. 21 RT Means and S.E. for complete data (Task 1).

*SDT Parameters (Hit Rate, FA Rate, **c** and **d'**)*

Results of the analysis of variance (ANOVA) for the within-subjects factor Ethnicity (Black, White, and Neutral) showed no significant main effects or interactions on participants' Hit and FA rates.

Moreover, the analysis found no significant differences in *criterion* (***c***) values and sensitivity parameter values (***d'***).

Discussion (Study 4 - Task 1)

Police officers showed, as in (Correll et al., 2007) that they were slower in responding as compared to Task 1 of the previous study, but with the same tendency: faster in shooting armed targets as compared to not shooting unarmed ones. The effect size of type of target (armed *vs* unarmed) increased (Task 1, Study 3 r = 69; Task 1, Study 4 r = 81). It could be perhaps the evidence that police officers are more weapon-concerned and experienced.

RTs showed the same tendency which were revealed for the control task (No IAPS pictures presentation before the FPST) and reported in the previous section (cfr. Page 113).

Task 2 (Valence = Positive)

Two analyses of variance (ANOVA) were computed for each dependent variable as for Task 1:

a) Arousal of the IAPS pictures (Arousal), Ethnicity, and Type of object held up by the target (Object, only for RTs) for corrected responses;

b) Arousal of the IAPS pictures (Arousal), Ethnicity, and the RType (only for RTs).

The design included two or three within-subjects factors:

a) Arousal (Low *vs* High), Ethnicity (Black, White, and Neutral) for SDT parameters and Object (weapon and tool) for RTs.

b) Arousal (Low *vs* High), Ethnicity (Black, White, and Neutral) for SDT parameters and RType (Hit, CR, Miss, and FA) for RTs.

Reaction Times

The analysis of variance (ANOVA) of the mean reaction times as in Correll et al. (2002), performed on correct responses (9% data dropped), treating Arousal (Low and High), Ethnicity (Black, White and Neutral) and Object (weapon and tool) as within-subjects factors revealed a significant main effect for Object [$F (1, 52) = 41.193$, $p < .01$, $r = .66$] (see Table 4.22 for Means and S.E., p. 135). Moreover, the analysis revealed a significant main effect for Ethnicity [$F (2,104) = 5.709$, $p < .005$] (see Table 4.23 for Means and S.E., p. 135).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RTs on Black targets as compared to Neutral [$F (1, 52) = 6.932$, $p < .05$], with a medium effect size ($r = .34$); on White targets as compared to Neutral [$F (1, 52) = 9.540$, $p < .05$] with a medium effect size ($r = .39$).

Moreover, results show participants' RTs were affected by the interaction between Arousal and Object [$F (1, 52) = 20.453$, $p < .001$] with a large effect size ($r = .53$) (see Table 4.24 for Means and S.E., p. 135).

Furthermore, results show participants' RTs were affected by the interaction between Prime and Object [$F (2, 104) = 26.068$, $p < .001$] (see Table 4.25 for Means and S.E., p. 135).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RTs when targets were Black compared to Neutral on Armed Target [$F (1, 52) = 39.743$, $p < .001$], with a large effect size ($r = .66$); whereas the difference was not significant on White targets as compared to Neutral when Armed [$F (1, 52) = 2.334$, p = n.s.]. Moreover, results show participants' RTs were affected by the interaction between Arousal, Ethnicity, and Object [$F (2, 104) = 20.848$, $p < .001$]. (see Table 4.26 for Means and S.E., p. 136).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RTs when Low Arousal Positive IAPS pictures were presented before Black Armed targets as compared to Neutrals [$F (1, 52) = 25.817$, $p < .001$], with a large effect size ($r = .57$); whereas the difference was not significant on White Armed targets as compared to Neutrals [$F (1, 52) = .580$, p = n.s.].

Results of the second analysis of variance (ANOVA) for the two within-subjects factors Arousal (Low and High) and RType (Hit, CR, Miss, FA) of control trials (Neutral Prime) show participants' RTs significantly differed in relation to the RType they gave [$F (3, 45) = 7.037$, $p = .001$] (see Table 4.27 for Means and S.E., p. 136).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RType on: Hit responses as compared to CR [F (1, 15) = 7.719, p< .05], with a large effect size (r = .58); CR responses as compared to Miss [F (1, 15) = 12.734, p < .005] with a large effect size (r = .68).

No significant difference of RType was found on Miss responses as compared to FA [F (1, 15) = 4.262, p = n.s.].

No other significant main effects or interactions were found.

Tables for RTs: Task 2, Study 4 (Means and S.E)

OBJECT	MEAN (ms)	S.E.
Weapon	455* r = .66	6.833
Tool	479	6.813

Table 4. 22 Object: RT Means and S.E. for correct responses (Hit and CR, Task 2).

ETHNICITY	MEAN (ms)	S.E.
Black	465* r = .34	6.742
White	465* r = .39	6.600
Neutral	470	6.617

Table 4. 23 Ethnicity: RT Means and S.E. (Task 2).

AROUSAL	OBJECT	MEAN (ms)	S.E.
Low	Weapon	449** r = .53	6.844
	Tool	484	7.078
High	Weapon	461	7.192
	Tool	474	6.875

Table 4. 24 Arousal*Object: RT Means and S.E. for the interaction (Task 2).

ETHNICITY	OBJECT	MEAN (ms)	S.E.
Black	Weapon	464** r = .66	7.019
	Tool	465	6.755
White	Weapon	449	6.843
	Tool	481	7.460
Neutral	Weapon	451	7.427
	Tool	490	7.038

Table 4. 25 Ethnicity*Object: RT Means and S.E. for the interaction (Task 2).

Tables for RTs: Task 2, Study 4 (Means and S.E)

AROUSAL	ETHNICITY	OBJECT	MEAN (ms)	S.E.
Low	Black	Weapon	449** r = .57	7.172
		Tool	480	7.287
	White	Weapon	448	7.255
		Tool	480	7.072
	Neutral	Weapon	449	7.289
		Tool	491	8.005
High	Black	Weapon	480	8.061
		Tool	451	7.509
	White	Weapon	450	7.074
		Tool	482	8.445
	Neutral	Weapon	453	7.977
		Tool	489	6.744

Table 4. 26 Arousal*Ethnicity*Object: RT Means and S.E. for the interaction (Task 2).

RTYPE	MEAN (ms)	S.E.
Hit	452* r = .58	18.430
CR	490* r = .68	16.582
Miss	388	23.344
FA	443	13.997

Table 4. 27 RT Means and S.E. for control trials (Task 2).

*SDT Parameters (Hit Rate, FA Rate, **c** and **d'**)*

Results of the analysis of variance (ANOVA) for the two within-subjects factors Arousal (Low *vs* High) and Ethnicity (Black, White, and Neutral) showed no significant main effects or interactions on participants' Hit and FA rates.

Moreover the analysis found no significant differences in *criterion* (***c***) values and sensitivity parameter values (***d'***).

Discussion (Study 4 - Task 2)

It is interesting to note that police officers were not affected, like civilians in all the previous studies, by the stimuli presented before either the WIT or the FPST. In fact, police officers, even in this task where IAPS pictures were presented before the main task, shot armed targets significantly faster as compared to deciding not to shoot unarmed ones, and confirmed the tendency (Task 1 of this study; Correll et al., 2007) that police officers respond more slowly.

Moreover, police officers demonstrated that they use time (longer latencies) to overcome any stereotype activation. In fact, no significant effect of ethnicity, either main or interaction with other variables, was found in SDT parameters, whereas latencies in shooting Black armed targets were significantly longer as compared to White and Neutrals.

Moreover, in contrast with previous results, arousal had a negative effect on latencies.

It could be argued, according to results, that police officers efficiently control stereotype activation at the expense of latencies, that is, longer latencies equal no bias in Hit and FA rates or *criterion* (***c***).

Task 3 (Arousal = High; Valence = Negative)

Two analyses of variance (ANOVA) were computed for each dependent variable:

1. Type of the IAPS pictures (IType), Ethnicity, and the Object (only for RTs).
2. Type of the IAPS pictures (IType), Ethnicity, and the RType (only for RTs).

The design included two or three within-subjects factors:

1. IType (Generic, Assault, Armed Assault), Ethnicity (Black, White, and Neutral) for SDT parameters and Object (weapon and tool) for RTs.
2. IType (Generic, Assault, Armed Assault), Ethnicity (Black, White, and Neutral) for SDT parameters and RType (Hit, CR, Miss, and FA) for RTs.

Reaction Times

The analysis of variance (ANOVA) of the mean reaction times as in (Correll, Park, Judd, & Wittenbrink, 2002), performed on correct responses (8% data dropped) treating IType (Generic, Assault, Armed Assault), Ethnicity (Black, White and Neutral) and Object (weapon and tool) as within-subjects factors revealed a significant main effect for Object [$F(1, 52) = 26.714$, $p < .001$, $r = .58$] (see Table 4.28 for Means and S.E.).

Moreover, the analysis revealed a significant main effect for Ethnicity [$F(2,104) = 3.279$, $p < .05$] (see Table 4.29 for Means and S.E.).

Post hoc comparisons (Bonferroni corrected) revealed a significant difference of RTs on White targets as compared to Neutral [$F(1, 52) = 5.671$, $p < .05$], with a medium effect size ($r = .31$); whereas no difference was found on Black targets as compared to Neutral [$F(1, 52) = 2.271$, p = n.s.].

No other significant main effects or interactions were found.

The second analysis was not performed due to lack of data for Miss and FA responses.

Tables for RTs: Task 3, Study 4 (Means and S.E)

OBJECT	MEAN (ms)	S.E.
Weapon	454** r = .58	6.364
Tool	479	6.936

Table 4. 28 RT Means and S.E. for correct responses (Hit and CR, Task 3).

ETHNICITY	MEAN (ms)	S.E.
Black	466	6.372
White	463** r = .31	6.627
Neutral	469	6.034

Table 4. 29 Ethnicity: RT Means and S.E. (Task 3).

<u>*SDT Parameters (Hit Rate, FA Rate, **c** and **d'**)*</u>

Results of the analysis of variance (ANOVA) for the one within-subjects factor IType (Generic, Assault, Armed Assault) for Neutral trials show participants' HRates were not affected by the IType [F (2, 104) = 1.263, p = n.s.] (see Table 4.30 for Means and S.E.).

Results of the same analysis for FARates showed participants' FARates for Neutral trials did not differ in relation to the IType [F (2, 104) = .114, p = n.s.] (see Table 4.31 for Means and S.E.).

Results of the analysis of variance (ANOVA) for the two within-subjects factors IType (Generic, Assault, Armed Assault) and Ethnicity (Black, White, and Neutral) showed no significant main effects or interactions on participants' Hit and FA rates.

Moreover the analysis found no significant differences in *criterion* (***c***) values and sensitivity parameter values (***d'***).

ITYPE	MEAN	S.E.
Armed Assault	.879	.014
Assault	.867	.013
Generic	.891	.011

Table 4. 30 IAPS picture type presented before the FPST: Hit Rate Means and S.E. (Task 3).

ITYPE	MEAN	S.E.
Armed Assault	.130	.015
Assault	.123	.013
Generic	.123	.011

Table 4. 31 IAPS picture type presented before the FPST: FA Rate Means and S.E. (Task 3).

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Discussion (Study 4 - Task 3)

In this task police officers showed the same tendencies of the previous task. In fact, even High Arousal Negative pictures, in general, affected their readiness to shoot armed targets faster than not shooting unarmed ones.

Furthermore, whereas police officers' Hit rates were affected as were civilians, FA rates showed a different tendency. In fact, police officers were affected in their FA rates proving to be more sensitive to armed assault IAPS pictures than the other two categories (generic and assault) and to be more prone to misperceive the threat of armed targets in that condition (FA rate for Armed Assault = .13; Assault = .123; Generic = .123).

In this task, as in the previous one, police officers demonstrated that they cognitively discriminate between necessary information for the successful result of the primary task (i.e., shooting) and information that could be sources of lethal errors (i.e., racial cues).

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General Discussion (Study 4)

Study 4 was performed on 53 Italian police officers to investigate if their specific training or the general exposure to weapons and crime-related stereotypes would have been comparable to civilians' effects on their performance in the FPST.

Results of this study demonstrated police officers were not affected by any eventual stereotypic association at the expense of time. In fact, police officers were slower in responding, particularly when presented with arousing stimuli.

It is interesting to note that contrasting the findings of the previous studies (Study 1, 2, and 3), police officers responded faster in shooting armed targets than un-armed ones either in the non-IAPS picture control condition or in the two conditions where IAPS pictures were presented before the main task. In fact, police officers were never affected in their reactions to shooting armed targets faster.

Moreover, police officers demonstrated they were able to use stimuli to enhance their performance. In fact, they were more accurate (higher Hit rates) and less prone to misperceive objects displaying a decrease in errors, specifically, deadly ones (FA rates).

Results for police officers support the hypothesis that being more motivated in detecting armed targets may alter the threshold at which weapons would be detected as well as predicted in fact, armed assault pictures negatively affected police officers' FA rates demonstrating they were more sensitive to armed assault IAPS pictures than the other two categories (generic and assault) and more prone to misperceive the threat of armed targets in that condition (FA rate for Armed Assault = .13; Assault = .123; Generic = .123).

It may be that their exaggerated form of attentional bias toward weapons, given their experience with guns, or their motivation to detect dangerous objects, or their facility to search in their memory weapon images for comparison, was triggered by the presence of a deadly weapon in the environment (IAPS picture) leading to errors.

The different tendency displayed by police officers in Hit rates as compared to civilians is also intriguing.

In fact, whereas civilians: 1) displayed attention shifting toward weapons when a weapon was present in the IAPS pictures; 2) when a weapon was not present seemed to have suppressed the shooting reaction; 3) kept a higher level of awareness when information of weapons was not definitively excluded; police officers seemed to be more visually tuned into detecting armed targets under uncertainty. In fact, when the information of a weapon was not clearly excluded, police officers displayed the maximum Hit rates.

It is comforting that real weapon holders showed they have no response bias toward particular ethnical groups and, thus, demonstrated that they cognitively discriminate better between necessary information for the successful result of the primary task (i.e., shooting) and information that could be sources of lethal errors (i.e., racial cues).

The problem is that police officers control the effect of arousing stimuli, negative affect states, and stereotypic associations at the expense of latencies and it could cause them injuries, or being killed when confronted with armed suspects.

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Conclusions for the First Person Shooting Task (Studies 3 and 4)

The aim of Studies 3 and 4 was to investigate if results commonly reported for paradigms such as Correll et al.'s FPST could be generalized in comparison to other participant populations such as Italians and Italian police officers. In fact, my interest was to investigate if the same pattern of researchers' results in this domain has documented could be generalised in comparison to ethnical groups where immigration histories and minority groups are different.
The supposition was that Italians would display the same pattern of results even if minority groups present on the Italian territory are the result of a completely different immigration history and from countries where morphologic characteristics are mostly the same.
Moreover, research in the split second decision domain, that investigate decisions such as shooting behaviour, is consistent with the fact that police officers show a robust racial bias in their latencies when called to a *shoot/don't shoot* decision.
In fact, Correll, Wittenbrink, Park, Judd, & Sadler (2008) report that whereas targets' ethnicity didn't affect police officers' ultimate decision, it affects their reaction times showing that police officers overcome stereotypes, even if they process racial information and access relevant stereotypes too, avoiding their interference in final decisions.
On the other hand, evidence for racial bias in SDT parameters in police officers are contrasting. In fact, Correll, Wittenbrink, Park, Judd, & Sadler (2008) are not consistent with other research showing police officers display the racial bias in the SDT analysis (Plant, Peruche, & Butz, 2005).
Sim & Correll argue that training is what helps in overcoming the influence of prevalent cultural stereotypes on the decision to shoot because it may improve object-based judgements or may promote cognitive control, reducing the influence of stereotypes, thanks to more controlled responses (Sim & Correll, 2009).
In general, results of Study 3 were very similar to results obtained with the WIT used in the previous studies presented for this research and from Payne, Lambert, & Jacoby (2002), Payne, Shimizu, & Jacoby (2005), and partially replicated findings from the literature of reference (Correll, Park, Judd, & Wittenbrink, 2002; Correll et al., 2007).
The task was more naturalistic than the simple task of categorising objects and probably it may have motivated participants more in detecting armed targets altering the threshold at which weapons were detected.
Interestingly, results showed how arousal and valence interact differently with ethnicity, supporting the hypothesis that arousing cues could be selectively transferred from a source to another, "overriding" the valence.
In fact, whereas positive affect state eliminated the response bias toward Blacks and weapons (participants detected faster un-armed targets that armed ones and no difference was found for ethnicity), positive arousing stimuli affected participants' RTs in shooting faster armed Black targets as compared to Neutrals and Whites.
Moreover, it was demonstrated that the content of the stimuli affected the tendency to shoot and modulated associations.
In fact: 1) Armed Assault pictures lowered the level of FA rate values for Blacks as compared

to Neutral targets; 2) Assault pictures enhanced Hit rates for Blacks; 3) whereas Generic type of IAPS pictures enhanced Hit rates for White targets. Moreover, in general, Armed Assault IAPS pictures favoured the tendency to shoot, whereas Assault type had little effect on shooting behaviour and Generic IAPS pictures only slightly affected the tendency to shoot.
Furthermore, results showed that racial bias was sensitive to the content of the stimuli present in the environment (IAPS pictures) supporting the hypothesis that associations between social categories, concepts, and affective states influence visual processing mechanism highlighting the fact that the more variables are introduced in the task less predictable would be the resulting association and the consequent response.
As compared to civilians, police officers were slower in responding, particularly when presented with arousing stimuli, demonstrating that they had overcome any eventual stereotypic association at the expense of time and, contrasting the findings of the previous studies (Studies 1, 2, and 3), police officers responded faster in shooting armed targets than un-armed ones either when cognitively activated or not and showing they were able to use stimuli to enhance their performance.
Motivation in detecting weapons, or their exaggerated form of attentional bias toward weapons, or their facility to search in their memory weapon images for comparison, could have altered the threshold at which weapons were detected as well as predicted, leading police officers to be more prone to misperceive the threat of un-armed targets when presented with Armed Assault IAPS pictures. In fact, it seems that their readiness in shooting was triggered by the presence of a deadly weapon in the environment (IAPS picture) leading to errors.
Moreover, police officers showed an interesting attitude: they seemed to be more visually tuned to detecting armed targets under uncertainty. In fact, when the information of a weapon was not clearly excluded, police officers displayed the maximum Hit rates. It seems that police officers, when faced with certainty, had an efficient cognitive control on reactions and that this “weapon awareness“ was enhanced under uncertainty in order to be ready for a weapon to be produced.
Whereas police officers were efficient and not biased demonstrating that they were able to discriminate better between necessary information and information that could be sources of lethal errors, to control the effect of arousing stimuli, negative affect states, and stereotypic associations, they used time (longer latencies), that was a dangerous strategy that could result in their becoming the victim.
A reason could perhaps be found in their use of lethal weapon awareness and in their knowledge of consequences. In fact, in a confrontation, contrary to what is believed, the only category which has most to lose, and which is fully aware of legal consequences of the use of firearms, are police officers.

General Conclusions

Applied cognitive psychology is not only laboratory techniques, experiments and theories that scientifically study how information is selected and processed. It is the attempt to explain how these processes work in order to understand how we behave in our daily life when we make decisions that may affect our wellbeing. In fact, we should not be surprised by the fact that cognitive evidence we may study in artefact situations may arise in natural settings (Legrenzi, 2001).

In applied cognitive psychology domain we have at least three principal categories of people who look for findings to be applied to their needs: the academic psychologist, who tries to understand how the (human) mind works; the world of applications who asks the psychologist the best way to "dress" entities such as products, services, organizations; and the non-specialized, who, ignoring the discipline, ingeniously use psychology to infer how his and others' minds work (Legrenzi, 2001).

Moreover, it is worth remembering how close the relation between emotions, cognition and social behaviour is (Legrenzi, 2001), aspects we cannot omit in the study of cognitive processes such as decision-making, problem-solving and judgement.

Specifically, a decision consists of a response in a situation where there are alternatives that can lead, with a certain grade of (usually subject estimated) probability, to some results. Results have consequences that are evaluated on a personal basis by the decision-maker. The ability to make decisions is necessary to adapt to environment because decisions can have important consequences for people's lives (Bonini, Missier, & Rumiati, 2008; Legrenzi, 2001; Rumiati, 1990).

This is particularly true when the decision to take a life has to be made.

Whereas the several categories of workers that usually need to carry guns or weapons, such as police officers or personal security experts, are aware that one day the decision to pull the trigger may be necessary, unfortunately they are not often trained on how to deal with psychological factors such as stress, anxiety and emotions (Nieuwenhuys & Oudejans, 2011) and, sadly, how they can affect the sudden decision to shoot.

Nevertheless, split-second decisions usually happen unexpectedly, and generally routine activities change immediately into a more complex situation (Burrows, 2007) where decisions are made under time pressure, in ambiguity or with conflicting information, and where consequences of errors are costly (Johnston, Driskell, & Salas, 1997); situations where it is unlikely that people can apply analytical and time-consuming strategies (Klein, 1993).

Shooting incidents are not easy to be simulated (especially in their arousing content) in a controlled and safe setting. Thus how people make decisions in these particular situations is not completely understood in science (Vickers & Lewinski, 2011) even if it is established that situational factors (e.g., time pressure, significance, accountability, irreversibility, etc.), personal characteristics (e.g., self-consciousness, anxiety, expertise, motivation, etc.), and task characteristics (ambiguity, complexity, familiarity, instability, etc…) influence the decision-making strategy (Beach & Mitchell, 1987).

Nevertheless, it is widely accepted that cognitive processes are influenced by emotional states, that information processing is reduced in high stress situations and that emotions may influence cognitive control's components differentially, increasing the possibility of biased judgements (Gray, 2001).

Police officers usually make decisions at different levels of stress and often face high levels of acute tension and pressure. It is reported that their speed of performance increases giving less time to be devoted to accuracy when under anxiety at the expense of efficiency because, under threat, they become more stimulus-driven, resulting in a decline of performance (Nieuwenhuys & Oudejans, 2011; Oudejans, 2008; Oudejans & Pijpers, 2010).

When, in February 1999, four White New York police officers shot and killed an unarmed Black immigrant from West Africa (Amidou Diallo), it sparked accusations of racial profiling and violation of human rights against law enforcement agencies, and many researchers, such as Payne (2001, 2006), Payne, Shimizu, & Jacoby (2005), Correll, Park, Judd, & Wittenbrink (2002), and Correll et al. (2007), tried to shed light on cognitive processes implied in split-second decisions, investigating response bias in objects identification and shooting behaviour when stereotypes are activated.

Whereas Payne (2001) tried to disentangle the processes, either automatic or controlled, which were involved in objects categorisation using an Evaluative Priming Task, Correll, Park, Judd, & Wittenbrink (2002) developed a videogame where the decision to shoot an armed target was required in order to investigate the effect of target's ethnicity on the shooting decision.

Nonetheless, social psychology researchers have documented stereotypic associations between Black Americans and violence and/or criminality since the fifties, highlighting that these stereotypic associations are robust (and automatic), and affect object categorisation (weapon *vs* tool, Payne, 2001), increase the speed in shooting at armed targets (Correll, Park, Judd, & Wittenbrink, 2002; Correll et al., 2007), and enhance the probability that Black targets are erroneously shot (Correll, Park, Judd, & Wittenbrink, 2002; Correll et al., 2007; Greenwald, Oakes, & Hoffman, 2003; Plant & Peruche, 2005; Plant, Peruche, & Butz, 2005).

Payne (2006) proposed that the stereotypic association that links Afro-Americans to violence and weapons could be semantically linked to fear or anger, thus, it can automatically lead to stereotypic responses; when cognitive control is impaired automatic impulses overcome intentional responses.

In fact, according to Payne (2006), there are two factors that result in a biased response: the stereotypic association that serves as an automatic impulse and the degree of intentional control which could be imposed on responses (Payne, 2006).

On the other hand, automatic responses (non-controlled) are provided when control is limited by the time pressure or depleted by, i.e., an exertion of sustained cognitive effort (Payne, 2006).

Therefore, automaticity in activating stereotypic associations (i.e. Afro-Americans and violence or crime) and cognitive control ability or failures are important, according to (Payne, 2006), in understanding the ***weapon bias***.

On the other hand, Correll, Park, Judd, & Wittenbrink (2002) sustain that deductive inference is used in associating the category trait of the target's ethnic group to the target itself and, without any relation to racist feelings or a particular dislike of or prejudice toward ethnic groups, simply a stereotype is endorsed, linking the concepts of Afro-American and violent or dangerous. The authors argue that the Shooter Bias is the result of a distorted interpretations of an ambiguous target that could intervene at several stages of the decision to shoot or not to shoot: 1) at the perception time of the object; 2) at the interpretation phase of the stimulus; and 3) when the final decision to shoot is made (Correll, Park, Judd, & Wittenbrink, 2002). Moreover, Correll, Park, Judd, & Wittenbrink (2002) sustain that bias may affect the interpretation of cues that participants process when they have to categorize an object (i.e., a weapon or a tool) and that the people may "see" a different object according to the stereotypic schema activated.

Therefore, perceptual classification of objects (gun *vs* tool) and behavioural decision (shoot *vs* do not shoot) are affected by bias and explanations that might account for it are distorted perceptions and cognitive control failure (Payne, Shimizu, & Jacoby, 2005).

According to the results of the present research, I would add that a central role is played by motivation, affect states and expectation.

In fact, first of all, results support the hypothesis that object categorization, either in the WIT or in the FPST, is affected by imagery that has the power to interfere with perception. Indeed, imagery uses the same mechanism perception uses for processing environmental information (Marucci, 2009).

People are more motivated to detect weapons than innocuous objects because threat has a central role in surviving; thus, humans have developed an efficient mechanism that has to detect survival-threatening stimuli in the environment.

When humans are called to detect a potential source of threat, i.e. a gun, they perhaps enhance their ability to detect it by priming their mind, imagining the object constructing it mentally. Then, people proceed by comparing real life objects with mental image objects using a faster matching versus a slower mismatching process, and latencies of responses result accordingly.

As proposed by Neisser (1967), Marr (1976, 1982), and Marr & Nishihara (1978), there are at least two levels of visual information processing. The first level works more automatically, pre-attentive, in a parallel-processing way managing information simultaneously and will-independent. The second level is sequential and depends on the will of the observer. That is: the visual system starts to code, disaggregate in a certain number of simple characteristics that are evident and automatically detectable, then attention starts to identify and recognise the object (Marucci, 2009).

In this, affect states influence the orientation toward threatening or non-threatening stimuli facilitating, i.e., the detection of weapons or tools. It has, in fact, been shown that relevance is a predictor of attention allocation (Dalgleish, 1995; Marucci, 2009; Mogg, Bradley, Field, & De Houwer, 2003).

Furthermore, arousal makes social categories more salient (Wilder, 1981) and facilitates associations, especially stereotypic ones, and intensifies ongoing behaviour even when residual (Zillman, 1978). Furthermore, arousal, causing incoherent cognitions and biased information-processing or attitude-changing, has important effects on attention (Easterbrook, 1959), narrowing the focus and limiting the amount of information or cues an individual could process.

When aroused, even if positively, people display bias and the response bias is exacerbated when arousal states are the consequence of negative arousing activation.

Thus, positive affect states facilitate tools detection, whereas negative states facilitate weapons detection, and arousal facilitates stereotypical associations.

In addition, this research found evidence that dissociation between arousal ratings and behavioural responses in shooting could be caused by different types of stimuli. Like Scherer (2001) proposed, stimuli are sequentially evaluated not starting automatically from the evaluation of the valence or threat but rather, determining how relevant the event is for the person. The nature of the unfolding emotion process is influenced, by the initial relevance check and the consequential regulation of attention to detect the stimuli's characteristics (Scherer, 2001).

In this, it is interesting to note that specific training or awareness help Inhibiting improper reactions. In fact, police officers are not affected by stereotypes and affective states in their ultimate decision. Like Sim & Correll argue, improving object-based judgements or promoting cognitive control with training reduces the influence of stereotypes (Sim & Correll, 2009).

On the other hand, as reported by Correll, Wittenbrink, Park, Judd, & Sadler (2008), whereas targets' ethnicity does not affect police officers' ultimate decision, it affects their reaction times showing that police officers overcome stereotypes, even if they process racial information and access relevant stereotypes too, avoiding their interference in final decisions.

In fact, whereas it is comforting that real weapon holders showed they had no response bias toward particular ethnical groups, it is a warning that they control the effect of arousing stimuli, negative affect states, and stereotypic associations at the expense of latencies because it could result in their being shot when confronted with armed suspects.

It remains to be determined if police officers are not affected by ethnicity in their final decision because training: 1) enhances their ability Inhibiting stereotype-related information; or 2) makes them more skilled at object judgements; or 3) gives them more cognitive control over the influence of activated stereotypes; or 4) makes them more able to regulate themselves enhancing their ability to extract relevant cues from the task or in controlling the selection of responses (Sim & Correll, 2009).

I argue that training and the awareness of the consequences in using weapons plays an antagonistic role in the shooting behaviour of police officers.

From one point of view, training, in general, as argued by Sim & Correll, *might facilitate more accurate identification of objects and more controlled response execution in presence of relevant and irrelevant cues* (Sim & Correll, 2009, p. 32). On the other hand, to understand the consequences, in terms of wounding and physical injuries caused by a firearm, makes police officers more aware than civilians of the real meaning of shooting. Moreover, to have the daily opportunity to observe guns makes iconic mental representations of weapons more available in the imagery of police officers than that of civilians.

Furthermore, to know the legal consequences of the use of firearms functions as a booster for Hit rates but as an inhibitor in terms of reaction times. Police officers know that as the first round is shot a series of implications start and that is the reason why they take a little more time to be sure no mistakes are made.

From this research it appears that police officers are adequately trained to disregard information that is not essential for the successful execution of a shooting task even under negative affective states, when aroused or in specific contexts.

The variables (Valence, Arousal and Content of Stimuli) should be incorporated in more complex scenarios commonly used in police officers training with virtual simulators (i.e. the

Firearm Training System – FATS) to strengthen their ability in managing conflicting information and in self-regulating reactions under particular affective states, as well as under time pressure and acute stress.

Police officers shooting skills are taught in fields, in firearms ranges indoor or outdoor and with scenario training facilities, mostly focusing on bio-mechanical repetition of the shooting action in order to become faster and more accurate. Advanced training programmes for special squads incorporate stress inoculation or reality-based sections in order to enhance officers' reliability under particular conditions. Nonetheless, programmes, either basic or advanced, predominantly focus more on the training of action than on the training of the ability to better make decisions or properly judge the situation.

Police officers' shooting reactivity does not suffer a delay either in the action, or in the judgement, but in the decision.

However, training programmes for police officers are at present the most advanced, and result in an adequate method of training for the profession. Nonetheless, future advances in training programmes will surely have to focus on the decision (to shoot) phase, that is to say the ignition for the behaviour (shooting) in order reduce reaction times, and the eventuality the police officer would become the victim.

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“That until the philosophy which holds one race superior and another inferior is finally and permanently discredited and abandoned: That until there are no longer first-class and second-class citizens of any nation; That until the colour of a man's skin is of no more significance than the colour of his eyes; That until the basic human rights are equally guaranteed to all without regard to race; That until that day, the dream of lasting peace and world citizenship and the rule of international morality will remain but a fleeting illusion, to be pursued but never attained . . .”.

Haile Selassie I

Address to the UN General Assembly (New York City, NY; October 4, 1963)

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Thanks for sending me your thesis a while back. I got a chance to look at it, and the work was very impressive!
Best wishes for continues success,

Keith Payne