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Perceived lack of control promotes creativity

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ABSTRACT

The sense of lack of control has been shown to foster illusory pattern perception, superstition, conspiracy and religious beliefs. In two identical experiments we investigated whether the feeling of lacking control (vs. control) can also foster creative thinking, which we operationalized as the ability to produce associative and dissociative combinations of either related and unrelated concepts. Participants were asked to think about an incident in their life wherein they felt either to be in control or to lose control of the situation. Immediately afterwards, they had to perform a set of tasks tapping (divergent) creative thinking. In both experiments, we observed higher scores in all creativity tasks for participants who recalled loss-of-control events than for those recalling in-control events. Our findings suggest that compensatory processes, triggered by experiencing lack of control, can promote divergent thinking. We propose an account situated within current models of semantic control.

Creative thinking is conventionally defined as the capacity to produce novel and appropriate (i.e., useful, effective, or valuable) outcomes (Glavenau & Kaufman, 2021; Runco, 2014; Sternberg & Lubart, 1999; Runco & Jaeger, 2012; Sternberg, 2022) with a transformative effect on the creator's mind (Gabora, 2017). Creative thinking can be considered one of the pinnacles of human cognition: it underlies humans' cultural progress and problem-solving skills, as well as their abilities to understand natural and artificial phenomena, including the behavior of other human beings (Sternberg & Lubart, 1999). James (1880) wrote:

"But turn to the highest order of minds, and what a change! Instead of thoughts of concrete things patiently following one another in a beaten track of habitual suggestion, we have the most rarefied abstractions and discriminations, the most unheard of combination of elements, the subtlest associations of analogy; in a word, we seem suddenly introduced into a seething cauldron of ideas, where everything is fizzling and bobbling about in a state of bewildering activity, where partnership can be joined or loosened in an instant, treadmill routine is unknown, and the unexpected seems only law" (p. 456)

Nowadays, creativity is commonly seen as the result of a cyclic interplay between a productive component that generates novel outcomes and an evaluative component that selects (or rejects) the contextually appropriate (or inappropriate) outcomes. In this sense, creativity results from a dual-process architecture (see, e.g., Guilford, 1967): a more spontaneous, generative, unstructured, unbounded process – often termed 'divergent' – that provides originality and novelty to the creative act by exploring multiple solutions to the problem at hand; and a more controlled, structured, bound-to-the-context process – often termed 'convergent' – that evaluates the results of the cycling creative act against significant properties of the problem at hand.

In this paper, we focus on the divergent component. In line with associative theories (e.g., Mednick, 1962), we concentrate on the role of memory (specifically, the role of the way knowledge is organized and memory is accessed) in creative thinking. How can we conceptualize the link between memory and creativity? It stands to reason that creativity cannot result from the mere re-instantiation of what is already known for a given context: this might well result in contextually appropriate outcomes but will nevertheless miss the property of novelty. Novelty requires moving beyond the current organization of memory (De Pisapia & Rastelli, 2022): whatever the creative outcome is, it must consist of something that was not already available to the system - in that particular configuration - from the beginning. However, creative solutions or products cannot come from a vacuum. Associative theories assume that novelty emerges from variations and recombinations of accessible knowledge (Campbell, 1960). Mednick (1962) defined the creative process as "the forming of associative elements into new combinations […]. The more mutually remote [within the knowledge space] the elements of the new combination, the more creative the process or the solution" (p.221). In this perspective, the novelty of the creative act is tracked back to the ability to detect unique associations between concepts that were previously weakly/remotely associated, if not unassociated (Martindale, 1981, 1993).

One intriguing question is whether certain experiences (and the changes that they cause in cognition) can either permanently or temporally promote this ability. In this paper, we explore the hypothesis

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that the perception of lack of control, which can be experimentally induced (Kay, Gaucher, Napier, Callan, & Laurin, 2008; Landau, Kay, & Whitson, 2015), promotes the detection of associations between knowledge units in memory, that is, that perceived lack of control promotes divergent thinking. The rationale is as follows.

A fundamental motivational drive of humans is the desire to perceive control over the events of their lives (e.g., White, 1959, Seligman, 1975; Skinner, 1995). Perceived control can be broadly defined as the belief that one is capable of achieving desired (short- or long-term) goals while avoiding undesired events (see Landau, et al., 2015). Experiencing desired levels of perceived control is linked to higher self-esteem, less pathology, health practices, improved interpersonal skills and emotional functioning, and interpersonal success (Tagney, Baumeister, and Boone, 2004). However, specific circumstances (i.e., cognitions or events) can lead individuals to experience a (temporary) reduction of perceived control. Given that the experience of lack of control is an aversive state (Whalen, 1998), individuals are motivated to respond with compensatory strategies for restoring perceived control to desired levels (Kay et al, 2008). It has been proposed that one of these strategies is to interpret the different aspects of the situation that one is facing, even aspects that have nothing to do with the events causing the perception of lack of control, as they had a predictable structure (Whitson & Galinsky, 2008): in order to reinstate control, people tend to affirm structured interpretations of the world (i.e. simple and coherent interpretation of the physical and social environment) that are nonspecific and may not be associated with the control-reducing condition (Landau et al, 2015). Thus, for example, individuals experiencing lack of control may perceive as associated events that they would otherwise classify as either unrelated or weaklier related. The identification of a coherent interconnection among weakly-connected or unconnected events can help individuals to find meaning in these events, and make predictions about the future, which - in turn - can make them feel more in control of the environment (Ma & Kay, 2017). After experiencing lack of control, people might then be more prone to see relationships between entities belonging to ontological domains that are far from each other and perceive structured configurations when presented with randomly arranged stimuli. Evidence in favor of this hypothesis comes from studies showing that people who are asked to recall experiences in which they lacked control over a situation are more likely to perceive tangible objects in random visual patterns (e.g., noisy pictures of scattered dots and lines) and see certain events (e.g., getting one's idea approved by the boss or being fired) as the outcome of either potentially unrelated behaviors that precede these events (e.g., knocking on wood before the meeting with the boss or not having done it) or of the secret and coordinated actions of a group of allied individuals, that is, they are more prone to embrace superstitious and conspiracy beliefs (Whitson & Galinsky, 2008).

Research on the effects of lack of control has mainly focused on its effect on the perception of external events (e.g., visual stimuli or hypothetical episodes involving the participant or other people) and their relations. In the present paper, we focus instead on internal entities, specifically on semantic/knowledge representations. We hypothesize that if a) individuals perceive stronger relations between representations of events as a consequence of lack of control, and b) the effect extends to the representations of entities and categories in semantic memory, then individuals experiencing lack of control (vs. control) should perceive stronger relationships between distinct semantic representations. In other words, semantic representations that are usually considered unassociated (or only weakly associated) should be, under perceived lack of control, considered (relatively) more strongly associated. Given that the capacity to see associations between elements that are far apart within the semantic network is the hallmark of (divergent) creativity (Benedek, Könen, & Neubauer, 2012; Dietrich, 2019; Kennet & Faust, 2019; Mekern, Hommel, & Sjoerds, 2019), individuals experiencing lack of control should outperform individuals not experiencing lack of control in standard divergent creativity tasks.

To put this prediction to the test we carried out two experiments. Given the novelty of the specific hypothesis, we aimed to evaluate and in order to strengthen our conclusions, we planned two identical experiments. In both experiments, we tested the performance in five divergent creativity tasks of participants induced to experience either control or lack of control. Experiment 2 is an exact replica of Experiment 1 but with a different sample of participants. Since the two experiments yielded the same results, here we report and analyze them together, treating Experiment (Experiment 1 vs. 2) as a between-participants variable.

Method

Participants. Forty-four participants took part in Experiment 1 (Female = 26, age:18-24). Fifty participants took part to Experiment 2 (Female = 25, age: 20-40). The size of the samples was based on Whitson and Galinsky (2008). Participants were students at the University of Padova who volunteered to participate in the experiments and were all native speakers of Italian.

Design. Both Experiment 1 and Experiment 2 consisted of two between-participants conditions: control and lack of control. There were two dependent variables: 'fluency' and 'novelty' of the responses (see 'Procedure' below).

Materials. Participants responded to 5 types of divergent creativity tests. In all tests, the items required the generation of as many responses as possible in a fixed (2 mins) amount of time. Responses consisted of simple words or brief expressions that meet a given criterion, which differed according to the test (e.g., the uncommon uses for an object, the implications of an unusual situation, the elements of a given object category, etc.), The tests were: alternative uses ('U', 3 items), production of words associated with a given pair of words ('A', 6 items), production of words not associated with a given word ('UN', 6 items), category fluency ('CF', 2 items), and unusual scenario ('S', 2 items) (see: Kaufman, Quilty, Gray, et al., 2016; Silvia, Winerstein, Willse, et al., 2008). Stimuli and instructions were printed on a sheet of paper and participants had to write their responses on it. See Appendix A for a description of the stimuli.

Procedure. Participants were tested individually in a quiet, sound-attenuated, and dimly-lit room. Upon their arrival, participants were alternatively assigned to either the control or lack of control condition. Control and lack of control were primed as in Whitson and Galinsky (2008): participants were told that they would have to perform a series of unrelated tasks and the first task was to write about an autobiographical episode involving either a control or lack of control experience. Participants in the lack of control condition were asked to recall an experience in which they felt they lacked control over the situation. Participants in the control condition were asked to recall an experience in which they felt they had full control over the situation (see Appendix B). Once they had written their autobiographical episode, participants in both conditions were asked to perform the same set of creativity tasks. Two dependent variables were measured in these tasks: "fluency" and "novelty". For each participant, the experimenters counted the number of responses to each item of the creativity tests (i.e., the 'fluency' score). In addition, for the U and S tests only, four independent judges (two in each experiment) evaluated each response of each participant in terms of perceived 'creativity' on a Likert-like scale in which the lowest score (i.e., 1) corresponded to "not creative at all" (i.e., the "novelty" score). The judges were unaware of the purposes of the experiments and blind to the assignment of the participants to the experimental conditions.

Results

Fluency. For each participant and for each test, we calculated the average number of responses to an item. To get the scores of the five different tests on the same scale, raw scores were transformed in z-points. Mean standardized fluency scores of the control and lack-of-control conditions are reported in Fig. 1. Standardized fluency scores were analyzed

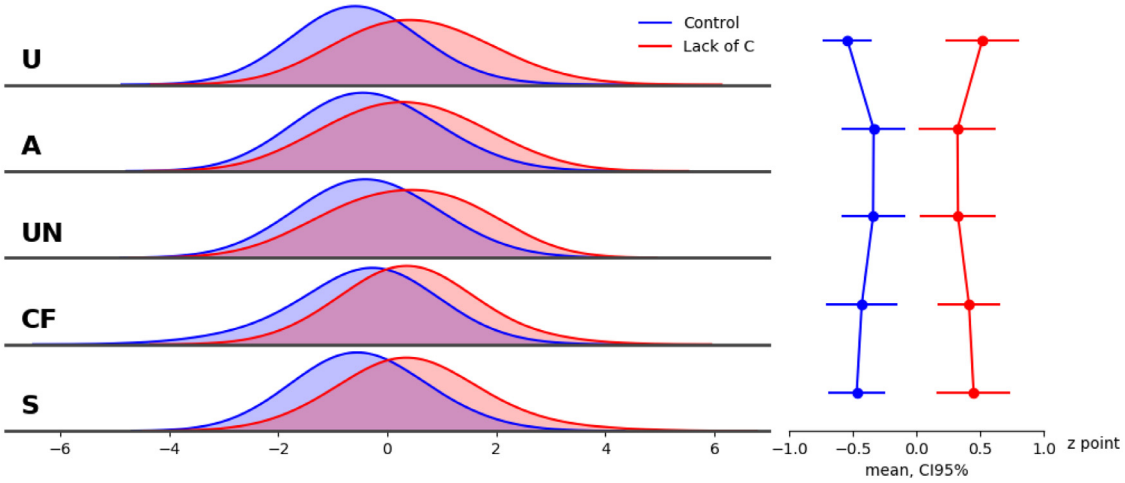

Fig. 1. Left, distributions of number of responses according to perceived control (z-scores). Right, mean number of responses and 95% confidence intervals. U = alternative uses; A = associated words; UN = not associated words; CF = category fluency; S = unusual scenario.

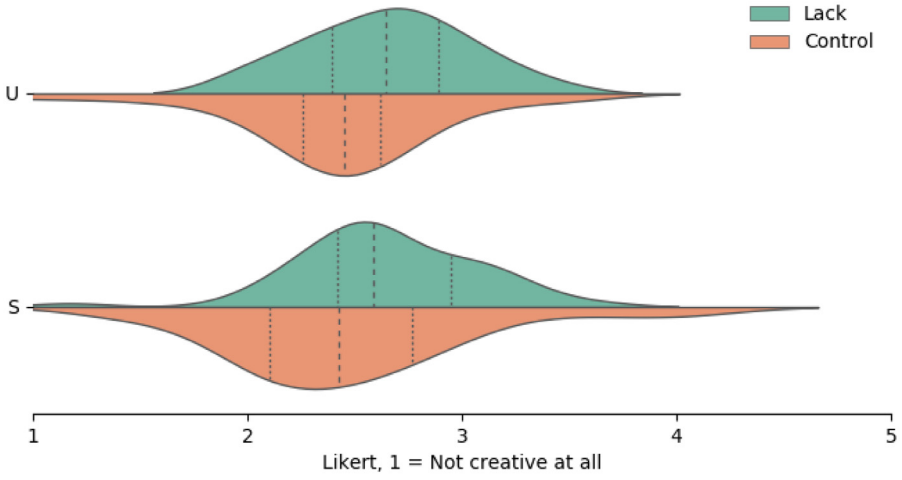

Fig. 2. Evaluations of responses' novelty according to perceived control. Vertical dotted lines represent quartiles. U = alternative uses; S = unusual scenario.

by mean of a repeated measure ANOVA with Tests of creativity (U, A, UN, CF, and S) as within-subject factor. Experiment (Experiment 1 vs. 2) and Perceived control (Control vs. Lack of Control) were the between-participants factors. The main effect of Perceived control proved significant, $F(1, 90) = 36.6$, $p < .001$, $\eta_p^2 = 0.289$. As shown in Fig. 1, in all the creativity tests the scores obtained by the participants in the lack-of-control condition were higher than those obtained by the participants of the other group. No other main effects nor interactions were significant.

Novelty. For each participant and for each item of both the U and S tests, we calculated a weighted novelty score: the novelty scores of the two judges for all the participant's responses to an item were summed and then weighted up by the number of responses given to this item. Within each test, these novelty scores were averaged. Novelty scores were analyzed by means of a repeated measure ANOVA with Tests of creativity (U vs. S) as within-subject factor. Experiment (Experiment 1 vs. 2) and Perceived control condition (Control vs. Lack of Control) were the between-participants factors. The main effect of Perceived-control proved significant, $F(1, 90) = 12.8$, $p < .001$, $\eta_p^2 = .125$. As shown in Fig. 2, in both the U and S tests, higher scores were obtained in the lack-of-control than in the control conditions. No other main effects nor interactions were significant.

Discussion

In two exploratory, identical experiments, we found that participants induced to experience lack of control outperform participants induced to experience control on a set of divergent creativity tests. These findings have implication for the understanding of both the role of access to knowledge and compensatory control (Key et al, 2008) in creativity. Moreover, the results of this study put these two issues in relation.

Theories of creativity have long emphasized the role of the semantic system for creative thinking (Abraham, 2014; Kenett & Faust, 2019; Sowden et al., 2015). Semantic system can be conceived as a store of concepts, facts and knowledge in general. Elements in the semantic memory can be accessed and retrieved and, if combined in new ways, facilitate creative thought (Kumar, 2021). In this context, semantic memory is conceived as a network of interrelated concepts (Collins & Loftus, 1975), with the structure of the network reflecting the organization of knowledge. Activation spreads within the network, so that interconnected concepts can be co-activated. Creative thinking involves connecting concepts that are – using space metaphorically – distant from each other in the network, and thus only weakly related (Mednick, 1962): the novelty of the combination of two concepts (e.g., Kenett, 2018a, 2018b) increases as the distance covered by the spreading of activation to connect (and combine) the two concepts increases. In other words, within this theoretical framework the combinations of semantically "distant" concepts are considered more creative than the combinations of semantically 'close' concepts (Heinen & Johnson, 2018; Kenett, 2019).

According to the associative theory of creativity (Mednick, 1962), the richness of an individual's semantic network determines whether this individual is more or less creative: more creative individuals have a richer associative structure of the semantic memory than less creative

individuals. More creative individuals are characterized by a 'flat' associational hierarchy (i.e., the associational structure is denser, with more and broader association among concepts), whereas less creative individuals are characterize by a 'steep' associational hierarchy (i.e. the associational structure is sparser, with fewer and more common associations to a given concept). Within a sparse associative hierarchy, the spreading of activation can get stuck into narrow, common, dominant semantic associations. In contrast, a richer, denser associative structure overcomes these limitations and facilitates the search process given that both close and distant associative relations can be established faster, with a more fluid process (Kenett, 2018b; Kenett & Austerweil, 2016; Volle, 2018).

Although the associative theory of creativity is still debated (Benedek & Neubauer, 2013), the concepts underlying the theory have recently received support from computational modeling of individual differences in creativity (Benedek et al., 2017; He et al., 2021; Kenett et al., 2014; Ovando-Tellez et al., 2022). Kenett et al. (2014) performed computational network analyses of free association data obtained from people who had been classified as high and low creative individuals with the aim of comparing the structure of their semantic networks. The network analyses showed that the structure of the semantic network of high creative individuals was characterized by both lower overall distance between the concept nodes and higher connectivity. Such a structure would allow a more effective spreading of activation within the network which, in turn, would permit reaching uncommon, farer, weakly connected concepts within the semantic system (Kenett et al., 2018). In sum, dense (vs. sparse) semantic networks would facilitate the spreading of the activation among connected concepts.

Along with a structured system of semantic representations, the current models of semantic cognition posit a further mechanism to account for semantic behavior: semantic control (Jefferies et al., 2020; Lambon Ralph et al., 2017). Controlled semantic processing regulates the retrieval of knowledge from the semantic memory in accordance with contextual and situational demands (Marko & Riečanský, 2021). It is argued that semantic control operates via two mechanisms, switching and inhibition. Switching allows the transition between concepts or cluster of concepts. Inhibition allows people to suppress contextually inadequate semantic activation and to limit interference from coactivated representations. The question of how control processes and structural properties of semantic representations interact is controversial and largely unclear (Abbott et al., 2015; Hills et al., 2012; Jones et al., 2015; Mayr, 2002; Marko & Riečanský, 2021). However, there is agreement on the fundamental functions of the interplay between semantic control and semantic structure: it allows contextually and situationally appropriate retrieval of knowledge and permits efficient, flexible, and adaptive behaviors.

Once triggered, activation is thought to automatically and ballistically spread from unit to unit, through the paths of the semantic network, thus following the architecture of the network, with related (i.e., connected) units being differently co-activated according to the strength of the specific connectivity. At any time, then, multiple units receive the activation signal and re-propagate it to connected units, producing an interconnected, multidirectional and reverberating pattern of activation within the system (Marko & Riečanský, 2021). The goal of the semantic control is to counteract automatic, structurally-driven co-activation of concepts in order to maintain directionality and adaptivity: it maintains contact with the relevant features of the triggering environment by enhancing the activation of appropriate concepts (or cluster of concepts) and by inhibiting co-activated units that are not appropriate, thus reducing activation-related noise.

Within this general theoretical framework, we can provide a possible account for the observed effect of lack of control on divergent creativity. According to the compensatory control theory (Kay et al., 2008), individuals experiencing lack of control are motivated to restore perceived control to desired levels. As mentioned in the Introduction, one way to restore perceived control is by interpreting the different aspects of a given context as they had a predictable structure (Landau et al, 2015), that is, by finding a simple, coherent, and clear interpretation of these aspects. In other words, perceived lack of control motivates the individual to seek (and thus experience) connections between features of the elements in a certain context, so that unconnected or weakly connected features are seen as related. That provides meaning to the context and allows the restoring of a sense of control.

How can that be achieved? We propose that experiencing lack of control motivates structure seeking which is achieved by altering the parameters controlling the operations of the executive functions. Executive functions (of which semantic control is a thematic instantiation) are a set of mechanisms that supervise and manage mental operations by selecting the context-relevant information and processes and by inhibiting the irrelevant ones (Norman & Shallice, 1986). Executive functions support goal-directed behavior and they are clearly tightly interconnected with motivation: their role is to control attention in order to do the mental work necessary to achieve one's goal (e.g., Engle & Kane, 2004). Motivation can thus critically alters the operative parameters controlling the deployment of such functions (cf. Pessoa, 2009)

It is therefore reasonable to suppose that the motivation to find structures following a lack-of-control experience affects the way in which executive processes (specifically, inhibitory control processes) are implemented. Indeed, it has been shown that certain experiences may affect inhibitory control mechanisms and temporally alter the strength with which irrelevant information is inhibited. Several different emotional and psychophysiological states can affect inhibitory control (see, e.g., Czapka, Schwieter, Festman, 2022), but the modulation of inhibitory control can also be strategic in nature that is, it can be context-dependent and driven by the task demands and task goals, even if not necessarily consciously implemented by participants (cf., e.g., the sequential modulation of response inhibition in response conflict task; Treccani, Cona, Milanese, Umiltà, 2018)

As reasoned above, a lack of control experience might trigger this strategic modulation: in order to reinstate control, after having experienced the loss of it, people tend to give structure to what they perceive, and this can be achieved by weakening the inhibitory control over the semantic representations that are activated by the input stimuli. Weakly coactivated representations are not filtered out – as it would happen in the presence of a relatively stronger inhibition – and become susceptible of selection. This has the consequence that representations normally considered as unrelated are now perceived as related. Downregulating inhibition has both gains and costs. A gain is that, upon the presentation of a semantic cue, weakly connected concepts are made available for selection, thus improving (divergent) creativity. A further gain is that weakly structured contexts are seen as more strongly structured, thus restoring perceived control. The costs are the possible false beliefs that may result from seeing relationships between unrelated things that belong to different ontological domains. This indeed might explain why individuals experiencing lack of control are keener to believe in superstition (Landau, et al., 2015).

Clearly, additional studies are needed to further explore this hypothesis and investigate the relationship between lack of control and the modulation of semantic inhibitory control. Starting from this hypothesis, further studies may also take advantage of the manipulation of lack of control to explore the trade-off between creativity and false (superstitious) beliefs predicted by our account.

Limitations

Our study has some notable limitations, and both our findings and our conclusions must be taken with caution. The first limitation concerns the experimental design. In both experiments we manipulated lack of control in a between-participants design, that is, the two levels of this manipulation were administered to two different groups of participants. This is typical in experiments that manipulate the sense of lack of control by inducing it in the participants (e.g., Whitson & Galinsky, 2008). By its nature, such a subtle manipulation cannot be easily realized with a within-participant design. A between-participant design opens to the

chance that a participant or subset of participants in any of the two groups had driven the effect because of some idiosyncratic and unknown individual features. It was precisely to mitigate the chances that this happened that we performed two identical experiments. A second limitation is that we did not take any measure of the participants' emotional state, which might be affected by the experience of lack of control (vs. control) and that it is known to affect performance in creativity tests. Given that the experience of lack of control is an aversive state (Whalen, 1998; see also Kay, Whitson, Gaucher, & Galinsky, 2009), if the experience of lack of control has triggered emotions in our participants, these emotions are likely to be negative emotions. According to some authors (e.g., Amabile et al., 2005; Clobert et al., 2016; Madan et al., 2019), negative emotions (vs positive) impair divergent creativity, which is the opposite of what we found. However, the picture is more complex than this (Kaufmann, 2003), as a significant facilitation effect of negative mood on performance has actually been observed in some creative problem-solving tasks, even if only when participants are thought to try to optimize their solution to the problem by evaluating the different options that had come to their mind (i.e., when considering the solutions produced in a relatively late phase, instead of the first, early solutions produced by the participants; Kaufmann & Vosburg, 1997; Kaufmann & Vosburg, 2002). Whether experiencing lack of control (vs. control) elicits negative or positive emotions, and whether the effects we found are mediated by those emotions is an issue that needs to be empirically addressed in future studies.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. - Tests of creativity. Original Italian version and English translation (in parenthesis). Only the Italian version was presented to the participants. Labels within square brackets were not presented to the participants

[Alternative uses (U)]

Ora ti presenterò diversi oggetti di uso comune e tu e tu dovrai trovare quanti più usi possibili diversi da quello tradizionale. (Now you will be presented with some common objects and you will have to find as many non-traditional uses as possible.)

-compact disc (compact disc)

-bottiglia di vino (bottle of wine)

-mattone (brick)

[Associated words (A)]

Ora ti presenterò un paio di parole e tu dovrai generarne altre collegate ad entrambe, es. estate…..altezza —> temperatura, aereo… (Now you will be presented with pairs of words and you will have to produce new words connected to both of them, for ex. summer-height —> temperature, airplane…)

-semaforo…conto (traffic light…bill)

-piede…fragilità (feet…fragility)

-fuoco…sole (fire…sun)

-libro…musica (book…music)

-montagna…mela (mountain…apple)

-cristalli…bianco (crystals…white)

[Not associated words (UN)]

Ora ti presenterò una serie di parole e dovrai elencarmi una lista di concetti non correlati per ciascuna di esse (Now you will be presented with a sequence of words and you will have to list a sequence of uncorrelated concpets for each of them)

-banana (banana)

-sapone (soap)

-mano (hand)

-montagna (mountain)

-cassaforte (safe)

-relax (relax)

[Category fluency (CF)]

Ora dovrai elencare il maggior numero di:

(Now you will have to list the largest number of:)

-Animali (Animals)

-Lavori (Jobs)

[Unusual scenarios (S)]

-Supponi che tutti gli esseri umani nascano con sei dita per mano invece di cinque: elenca tutte le conseguenze e/o implicazioni alle quali riesci a pensare. (Suppose all humans were born with six fingers per hand instead of five: list all the consequences and/or implications you can think of.)

-Elenca il maggior numero di cose bianche e commestibili che riesci a pensare. (List the largest number of white and edible things you can think of.)

Appendix B. – Maniuplation of (lack of) control

Control:

(Italian) Per favore richiama alla memoria un particolare incidente in cui qualcosa è successo e tu eri in completo controllo della situazione. Per favore descrivi la situazione in cui ti sei sentito completamente in controllo – cosa è successo, come ti sei sentito/a, ecc.

(English) Please recall from memory a specific event where something happened and you were in total control of the situation. Please describe the situation in which you felt in complete control – what happened, how you felt, etc.

Lack of control:

(Italian) Per favore richiama alla memoria un particolare incidente in cui qualcosa è successo e tu non hai avuto alcun controllo sulla situazione. Per favore descrivi la situazione in cui hai sentito una completa mancanza di controllo – cosa è successo, come ti sei sentito/a, ecc.

(English) Please recall from memory a specific event where something happened and you did not have any control on the situation. Please, describe the situation in which you felt complete lack of control – what happened, how you felt, etc

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