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# Producing, Preventing, and Explaining Persistent Complex Subliminal Stimulation Effects

BY

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#### **Abstract**

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Strong recent focus on unconscious processes has increased interest in subliminal stimulation and similar experimental technologies. Assumptions about the persistence of effects of unconscious stimulation are generally conservative, referring to seconds or minutes (Silverman, 1977; Velmans, 1991). In Study I, five experiments ( $N = 365$ ) showed complex effects of unconscious stimulation ten days after subliminal exposure, implying that persistence estimates need reevaluation. Experimental stimuli were "mommy and I are one" (MIO) and "mommy and I are dissimilar" (MIDIS), and neutral control stimuli. Effects consisted of higher correlations between measures pertaining to the self-mother relationship and measures of psychological adjustment.

These ethically problematic findings prompted investigation in Study II of whether debriefing information to participants could prevent persistent effects of subliminal stimuli, an issue not previously investigated. Two experiments ( $N=188$ ) tested two kinds of information to participants following subliminal MIDIS or control stimulation. Results showed different persistent effects depending on participant sex. Simple information about the stimulus was effective in preventing these, but elaborate information describing the effects and mechanisms for them was not. The findings have implications for ethical recommendations for subliminal research, and suggest that this unexplored area requires more attention.

In Study III, a theoretical account for the persistent effects is presented, based on unconscious activation of a relational schema containing goal motivation. Unless the goal is fulfilled or activation dissipates due to attributability or irrelevance of the goal, the activation will be maintained (motivated maintenance). Being unconscious, the influence results in automatic schematic processing of environmental cues, including perceptual, judgment, and behavioral biases. These in turn interactively maintain the activation of the schema (interactive maintenance).

The discussion includes the conclusion that previous estimates of the persistence of unconscious stimulation effects need revision. Theoretical and empirical questions concerning the studies are discussed and ethical research implications are considered.

*Keywords:* Subliminal stimuli, persistent effects, attachment, relational schema, ethics, debriefing, interaction, motivation, sex differences

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Study I:

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# INTRODUCTION

Consciousness, it seems, is being comprehensively dethroned as an explanatory factor behind much, if not most, of human behavior (Velmans, 1991; Wegner, in press). This dissertation is a contribution to that development. One of the most difficult problems facing psychological research, the nature of consciousness is fortunately not the present subject matter. Instead, unconscious processes are in focus, as part of the expanding research of the past few decades into the myriad ways in which psychology we are not aware of guides our behavior.

The dissertation concerns a discovery that may importantly impact psychological research. It may also turn out to be relatively inconsequential, rare, and so obscure that few insights will finally be gained from it. At present, the discovery deserves attention however because it is previously undocumented, theoretically exciting, and ethically problematic. My purpose is to describe the findings, describe two attempts at avoiding such findings, and then to explain them. The findings consist of very persistent effects of unconscious stimuli, and will be described in Study I. Such effects of research manipulations present both ethical and theoretical problems that Studies II and III, respectively, attempt to deal with.

## What You Don't Know Can Control You

Try for a moment, while reading this sentence, to consciously piece together the individual letters, understand how they stand in relation to one another, how they form words whose meaning is in turn affected by the words around them, and how these chunks of symbols form a representation in your brain of what the sentence says. Try again. A few things are worth noting about this exercise; namely that a) in spite of some effort, you probably couldn't do it at any significant level of detail, b) you understood the sentence very quickly anyway, and c) it still affected your behavior (if you are the least bit obedient). Also, since you already knew what it said, the meaning of the

sentence didn't really change when you went over it again, trying to consciously weed out what made it convey the particular meaning it does. This illustrates a few factors involved in unconscious functioning, which for obvious reasons is fairly difficult to consciously understand. We unconsciously and very quickly derive meaning from cues in the environment, we have incomplete insight into how this happens, and once formed, that meaning becomes authoritative and does not easily change, instead guiding our behavior without our being entirely aware of it or choosing that this should happen.

The existence of unconscious influence in everyday life is an entirely trivial point. We cannot be conscious of everything we do and how we do it. For example, tying our shoelaces, walking, speaking, and driving are all guided to a large degree by unconscious processing, which broad domain is also denoted by terms such as automaticity or implicit memory. The reason we have extensive unconscious capabilities has to do with efficiency. The very complex informational environments that the brain is required to handle are beyond the capacity of consciousness, which can contain only one or a few things at a time (Baars, Fehling, LaPolla, & McGovern, 1997; Bargh, 1997). Frequently performed actions and behaviors therefore become automatic, and consciousness becomes redundant and can turn to other things while brain processes continue to handle and filter information in the appropriate ways and carry out the behaviors that suit one's needs, within the situation's constraints. Much of automatic processing can be rendered explicit by an effort of recall or attention; we can notice how we are tying our shoelaces, and when not doing it we can recall in detail how it is done, albeit with some effort. Usually also, while learning a skill or habit we phenomenally experience the included objects, features, functions, and (sometimes) their associations. We can call behavior guidance automatic simply because we don't have to pay attention to what is guiding our behavior, other than, in the present example, our intention to wear shoes.

## Definitions of Unconsciousness

### Conscious vs. Unconscious

A common conclusion is that automatic processing is indeed the major way in which humans navigate through their environment throughout life, and this includes simple tasks as well as more complex tasks involved in everyday living (Bargh & Chartrand, 1999; Bargh & Ferguson, 2000; Reber,

1989; Wegner, in press), and research into unconscious functioning is the order of the day. Many terms have been used to denote the object of such inquiry, and their definitions have been various. For present purposes, *unconscious* means contents or processes that we cannot report being aware of, with *automatic* referring to processes and *subliminal* to external stimuli. Included here are contents and processes we cannot in principle become aware of (often termed *nonconscious*), such as how the visual system builds perceptions, as well as those we can become aware of, such as a stressful situation we have momentarily forgotten. The idea of a general perceptual threshold is no longer entertained, but the term subliminal continues to be used. Operational definitions of the term have been proposed, i.e., the *objective* and *subjective* threshold, referring to whether forced-choice responses indicate perception or not when participants claim they saw nothing (Cheesman & Merikle, 1986). The definition I endorse does stipulate lack of content reportability, but is silent with regard to the subjective and objective criteria.<sup>1</sup> This is because unconscious semantic activation has been achieved at levels of duration, energy, or signal-to-noise ratio below the objective threshold (Glassman & Andersen, 1999; Van Selst & Merikle, 1993), which was held not to be possible when the criteria were formed (Cheesman & Merikle, 1986). The subjective and objective threshold definitions, thus, may not be as relevant today as when they were proposed, and instead less demanding but nonetheless relevant criteria are common. These include simply asking participants whether they saw the stimuli in question (e.g. Chen & Bargh, 1997), asking whether participants understood that they were being affected by a previous prime (e.g. Bargh, Chen, & Burrows, 1996), or using stimulus durations that have previously been shown not to result in reportable perception (e.g. Abreu, 1999; Pierce & Lydon, 1998). All of these are consistent with the fairly simple criterion of unreportability. Neighboring suggestions rely on designs that dissociate explicit and implicit response types to show that the procedural difference between stimulation called subliminal and stimulation called supraliminal is valid (Merikle & Daneman, 1998). This operational definition however is overly prohibitive for many research areas, including the present one. For example, arguing that conscious instructions and subliminal priming lead to similar effects would by definition not be possible within such a paradigm, and yet interesting and useful demonstrations of this have been published (e.g. Chartrand & Bargh, 1996; Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001). The present boundary between conscious and unconscious, thus, hinges on lack of reflexive consciousness, that is, any percept or process that one cannot

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<sup>1</sup> For reference, the exposure types used in the present studies satisfy the reportability criterion, and may satisfy the chance recognition criterion of Cheesman and Merikle's (1986) objective threshold (Sohlberg, Billingshurst, & Nysten, 1998).

report being aware of at the time of its influence on behavior (including cognition, emotion, perception, etc.) is unconscious. This includes perception that has been conscious in the past but is not when its effects are produced.

## Automaticity and Implicit Memory

What then of definitions of unconscious contents and processes themselves? Automatic processes, and, by opposition, controlled ones have been appended with many lists of characteristics. For example, automatic processing is independent of cognitive resources, cannot be completely controlled, does not require attention, takes little if any effort, uses parallel processing, figures little if at all in awareness, employs holistic analysis, has high performance capacity, and is difficult to modify (Öhman, 1999). Controlled processing (basically equivalent to conscious processing) functions in the opposite way in all respects, with controllable, serial, fragmentized, effortful processing that is very limited in performance but effective at long-term memory imprinting. While important roles have been proposed for consciousness (Baars et al., 1997), automatic processing has greater capacity and processes greatly more information at any given time.

Automatic processing takes advantage of memory that is well learned and does not require conscious attention. Such memory is called *implicit memory*, as opposed to explicit or reportable memory, and is commonly and broadly defined as effects on current behavior that are attributable to past events, in the absence of conscious recollection of those events (Dorfman, Shames, & Kihlstrom, 1996). Motor, perceptual, and cognitive skills and habits are sometimes called procedural memory (Tulving, 1997), but this term has been used in contexts reminiscent of implicit memory as well (Bargh, 1997; Westen, 1998), and the terms will be used interchangeably here. For present purposes, automaticity and implicit memory are also equivalent, with the qualification that processes that are not learned but in-born may also be automatic, such as the fight-flight reflex and attachment motivation (thus departing somewhat from more traditional definitions of automaticity involving only learned skills; e.g. Logan, 1988). The focus, as implied and as will become clearer below, is on processing that is not controlled by conscious volition and that is not introspectively accessible. Such a view of unconsciousness captures a relevant range of phenomena with fair ecological validity, in that such processes, and the cues that trigger them, are abundant in everyday life. I will however especially be considering unconscious research manipulations since these are designed to be focused, accurate, and powerful, and therefore of more immediate ethical concern.

## Methodologies in Research on Unconscious Processes

Methodologies used in research on unconscious processes are almost as various as the questions investigated. This also means that the criteria for claiming that something is unconscious in a meaningful sense are quite different in different literatures. In social cognition, for instance, the 'ostensibly unrelated experiment' procedure is often used. Here, participants may first be given a task unscrambling sentences, which have been designed so that one group is exposed to a specific set of prime words included in the sentences. They are then thanked for their participation and "Oh, by the way" asked if they might participate in another experiment, claimed to be unrelated to the first. This procedure has yielded conclusions concerning many unconscious processes, such as automatic goal activation and stereotype priming (Bargh, 1997; Fitzsimmons & Bargh, 2003). Other methods use stimulation that participants *cannot* perceive, as opposed to not noticing the meaning of, in order to render the critical material unavailable for introspective access at the time of its influence. A common method is computerized backward masking, where a visual mask replaces the prime stimulus after some brief time period, generally ranging from 10 to about 100 milliseconds. Following this, a target stimulus is presented to which participants are required to give a response, and this response is affected by the preceding subliminal stimulus. Studies in social cognition (Greenwald & Banaji, 1995; Mikulincer, Gillath, & Shaver, 2002), affective priming (Murphy & Zajonc, 1993), perception and cognition (Marcel, 1983), and cognitive bias within the Stroop paradigm (Williams, Watts, MacLeod, & Mathews, 1997) have successfully used this procedure. It has been used without the target stimulus as well, simply to subliminally present a series of words that together connote some category or construct, which then affects responses on some subsequent task (Bargh & Chartrand, 1999; Glassman & Andersen, 1999; Pierce & Lydon, 1998).

Another method presents stimuli very briefly by way of a tachistoscope. Subliminal Psychodynamic Activation (SPA), to which the method used in the present studies owes its heritage, uses tachistoscopic subliminal stimulation technology (4-5 ms exposures) in order to investigate psychodynamic hypotheses. While for a long time controversial both in terms of empirical results and underlying theory, meta-analytic conclusions (Hardaway, 1990; Weinberger & Hardaway, 1990), focused individual difference studies employing modern theory and methodology (Birgegard & Sohlberg, 1999, 2001; Bruchhauser, 2001; Sohlberg & Jansson, 2001; Sohlberg, et al. 1998; Sohlberg, Birgegard, Czartoryski, Ovefelt, & Strömbom, 2000; Sohlberg, Samuelberg, Sidén, & Thörn, 1998), and theory development in other areas of psychology (e.g. Westen, 1998) have narrowed the gap between SPA and

mainstream psychology. In SPA, phrases of up to 5 words are used as stimuli, while in cognition research even single-word analysis is still under contention (Abrams & Greenwald, 2000). The issue of whether subliminal syntax-dependent verbal analysis is possible has been termed the "two-word challenge" (Greenwald, 1992; for a brief treatment, see Birgegard & Sohlberg, 1999). For present purposes, showing that subliminal activation can be limited to simple features (Abrams & Greenwald, 2000; Draine, 1997) does not mean that it is always limited to simple features. Examples of studies implying that syntax-dependent analysis is possible include Patton (1992), Waller and Mijatovich (1998), Birgegard and Granqvist (in press), Hardaway (1990), and Study I of the present dissertation (Experiment 4).

It appears also that there is no meaningful difference between different ways of triggering automaticity such as goal motivations, stereotypes etc. in terms of what is triggered: that is, the triggered content doesn't care how it was triggered. The specific form of subliminality is of less importance than that participants be unaware of the possible effects of a stimulus. A perspective that capitalizes on *priming without understanding*, thus, has begun to replace the more traditional terms perception without awareness (Bornstein & Pittman, 1992) or subliminal perception in many studies on unconscious processing (cf. Bargh & Chartrand, 1999; Chartrand & Bargh, 1996).

Probably most of the time, we do not disagree with our automatic behaviors, but merely delegate responsibility for standard, frequent operations away from the effortful awareness of conscious control (Bargh, 1997; Chartrand & Bargh, 1996). At times, however, there appears to be a motivated discrepancy between automaticity and the contents of consciousness. Examples of this are frequent in stereotype research for example, where stereotype-driven automatic biased evaluations are inconsistent with consciously endorsed self-reported racism (e.g. Devine, 1989, 2001; Ekehammar, Akrami, & Araya, 2003; Plant & Devine, 1998). As a telling example, Chen and Bargh (1997) demonstrated how stereotypes function as self-fulfilling prophecies. Subliminal African American stereotype priming produced hostility (which is a major trait associated with the African American stereotype in the US) in an *unprimed* interaction partner of the primed participant; thus, the activated stereotype produced itself. Further, increases in pathological behavior following subliminal priming of memories surrounding a significant other have been found (Patton, 1992; Waller & Mijatovich, 1998). In cases like these, investigating unconscious mental life becomes additionally relevant, and the importance of ethically responsible handling of the techniques involved is clear. Common to the above methods, however, is the assumption that effects are not only temporary but also very short-lived, and this assumption,

important to the ethical parameters of subliminal research, is what the present dissertation challenges.

## Complex Effects Depend on Existing Structures

At this point, I wish to distinguish between effects that are *complex*, which are in question here, and effects that are not. Effects of unconscious stimulation may be called complex when what is elicited in participants' responses is not what was presented in the stimuli, but something else and something more. This in contrast to classic language priming studies, such as word-stem completion, where for example subliminal priming with the word "trigger" increases the likelihood that the word stem "tri-" will be completed with "trigger" rather than "trick" or "triangle". Nothing very complicated has occurred between the prime and the response here, at least nothing that was measured. Such match between prime and response I call *one-to-one priming*.

The case in the present studies is quite different, however. Even though we may think that our reactions stand in some reasonably intuitive proportion to the events that triggered them (i.e. minor events leave us cold while groundbreaking events leave us gasping for air), this is not obviously the case in the present context. Participants in the studies I will be talking about look into a tachistoscope and are exposed to five-millisecond blinks of verbal stimuli. Consciously, they usually do not even see even a slight flicker, and have no idea what the exposures contained. Over a week later, they are still affected by those exposures in ways that do not simply match the presented stimuli, e.g., not merely as facilitated recognition of the stimulus words. In order for that to happen, I assume that existing memory structures need to be activated. This switches the issue of proportionality instead to the importance of the psychological structure, not the amount of energy it took to activate it.

A small and seemingly inconsequential cue may have a great impact given the right psychological circumstances, such as a subtle tension of the chest muscles in panic disorder, or a bottle top pointing at a police person searching for an armed suspect. While a relatively nonaffective prime trace, as exemplified in the one-to-one priming example above, may dissipate as quickly as some researchers contend that all subliminal traces do (e.g. Greenwald, 1992; Velmans, 1991), subliminally 'pushing someone's buttons' has consequences not exhaustively defined and contained in the trigger itself.

This highlights the idea that reactions to environmental cues depend on what we have learned previously, and on whether there is inborn preparedness to respond to certain types of cues. An important class of automaticity that has been receiving increased attention recently concerns social information processing. In that domain also, much of behavior is influenced by cues in the environment that automatically activate certain behaviors. Things we do automatically in the social domain include judging others (Abreu, 1999; Ekehammar et al., 2003), seeing and reacting to people's facial expressions (Dimberg, Thunberg, & Grunedal, 2002), matching behavior to others' behavior (Bargh & Ferguson, 2000; Berk & Andersen, 2000; Chen & Bargh, 1997), and whether we collaborate or compete (Bargh et al., 2001). More importantly here, memories associated with specific important people (i.e. significant others) can also be activated automatically. Unconscious priming studies involving relationship representations have shown a wide range of changes in affect, goal pursuit, associations, and nonverbal behaviors, and these effects in turn change the behavior of others around us (Andersen & Chen, 2002; Andersen, Reznik, & Manzella, 1996; Berk & Andersen, 2000; Chen & Bargh, 1997; Fitzsimmons & Bargh, 2003; Glassman & Andersen, 1999; Shah, 2003a,b).

## Representations of Relationships with Significant Others

For all humans, interpersonal factors are important and influential, and schemas relating to them are a central part of personality and psychological functioning (Baldwin, 1992; Baumeister & Leary, 1995). From early childhood on, associative learning lays the foundation for later interpersonal behavior and personality (Steele & Steele, 1998; van Ijzendoorn, 1995). Attachment theory (Ainsworth, Blehar, Waters, & Wall, 1978; Bowlby, 1969) postulates that inborn motivation to attach to caregivers fuels social learning, and that social learning lays the foundation for the management of further social encounters through internal working models (IWM's). An IWM is a memory representation involving the self, the other, and patterns of interpersonal relatedness. It represents an adaptation to the configuration and behavior of the social environment in the service of optimal attachment. This set of behaviors and expectations then serve as the default, automatic way to relate to new people and to oneself.

IWM's, then, are a stable, pervasive, automatic influence on subsequent relationships (Fraleay, 2002; Roisman, Madsen, Henninghausen, Sroufe, &

Collins, 2001; Steele & Steele, 1998). IWM and neighboring terms are a mainstay of research on adult relationships and social cognition (e.g. Andersen & Chen, 2002; Andersen, Reznik, & Manzella, 1996; Baldwin, 1999; Pierce & Lydon, 1998). I will use the term *relational schemas*<sup>2</sup> (Baldwin, 1992) for such attachment representations. Relational schemas do not by definition involve so-called significant others (Baldwin, 1992), but I will focus on such representations since they are likely to be more stable, contain more knowledge of the other and the relationship, have higher accessibility, and be more organized (Andersen & Cole, 1990; Chen, 2003; Fraley, 2002; Glassman & Andersen, 1999). Relational schemas contain the *if-then* contingency expectations associated with the interpersonal script, or the habitual ways of relating found within the relationship (Andersen & Chen, 2002; Baldwin, 1992, 1999; Chen, 2003). For example, "If I feel lonely, then I can turn to my friend", where the "if" is an objective situation and the "then" is the person's response. Also, representations of significant others, such as those found in some relational schemas, are especially likely to function as inference structures, compared, with, for instance, nonsignificant others (Andersen & Cole, 1990). Relational schemas are associated with interpersonal goals within the relationship, and activation of a relational schema includes activation of those goals (Fitzsimmons & Bargh, 2003; Shah, 2003b). Such activation, and the ensuing behaviors, do not require conscious choice but can be done nonconsciously, via subliminal primes or unobtrusive supraliminal priming (Andersen et al., 1996; Fitzsimmons & Bargh, 2003; Mikulincer, 1998; Shah, 2003b). For example, goals associated with the self-mother relational schema were investigated among university students, and some frequently reported goals concerned being successful (to make mother pleased and proud), caring about mother and showing her this, and presenting oneself positively (Fitzsimmons & Bargh, 2003). Such goals can be unconsciously activated via activation of the relational schema.

Although distinctions have been proposed between relational schemas and similar terms (e.g. *relational selves*; Andersen & Chen, 2002), the present discussion requires only what they have in common. Important similarities among these constructs are that they consist of implicit/procedural memory based on and containing attachment motivation, and include images of the self, the other, and typical styles of relating. Distinctions among these concepts do not touch upon these features but are rather matters of emphasis on,

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<sup>2</sup> Although the traditional schema concept was cognitive in nature and accessible to consciousness (although often operating outside awareness; Siegel & Weinberger, 1998), the relational schema includes important affective and motivational factors and is comprised in large part of implicit/procedural memory that is not easily available to introspection (Baldwin, 1992).

e.g., idiographic or normative aspects of the schemas (Andersen & Chen, 2002). Priming of a relational schema entails activation and use of a specific relational self associated with a significant other, as well as motivations and expectations deriving from that relationship. Once activated, relational schemas entail application of styles of interaction learned in that context to new people, including a range of effects, as noted above. Priming of relational schemas in ways that escape the awareness of participants is common in research (e.g. Glassman & Andersen, 1999; Mikuliner et al., 2002; Pierce & Lydon, 1998; Shah, 2003a,b), and it is, again, usually assumed that such research-related activation is "temporary".

## Relational Schema Activation by way of the Present Stimuli

It is important to argue that the experimental stimuli used in the present studies can indeed activate relational schemas, those stimuli being "mommy and I are one" (MIO) and "mommy and I are dissimilar" (MIDIS). As noted previously, these stimuli and the tachistoscope methodology stem from SPA, and a modern interpretation of SPA effects involves activation of associative networks involving motivation, emotion, self-concept, and expectancies, centered on a significant other (Sohlberg, et al., 2000; Sohlberg, Claesson, & Birgegard, 2003; Sohlberg & Jansson, 2002). Some examples of results will be useful. In a study using a Stroop color-naming task after MIO or control stimulation, effects were found in the experimental group on words such as "unity" (compared with neutral words), indicating possible category activation (Sohlberg, Arvidsson, & Birgegard, 1997). In another study, participants imagined writing a story and could choose from neutral, defensively autonomous, or symbiotic descriptors of the main character. After MIO compared with control stimulation, participants with a low degree of identification with mother preferred descriptors of the main character indicating "defensive autonomy". High-identified participants on the other hand preferred descriptors indicating "symbiotic oneness" (Sohlberg et al., 2000). This indicates the activation of individually different associative networks in response to MIO, consistent with idiosyncratically formed relational schemas. Further, Sohlberg and Jansson (2002) demonstrated false memory effects after MIO stimulation, indicating schema activation according to Baldwin's (1999) criteria. In addition, Siegel and Weinberger (1998) developed a scoring system for the projective Thematic Apperception Test (TAT) that captures a "oneness motive", which includes themes of close relationships and attaining

oneness with another. Oneness motive scores were significantly higher in a group subliminally stimulated with MIO than with a control stimulus.

## Longevity of Subliminal Stimulation Effects

Some researchers employ unconscious stimulation methods to study the bounds of subliminal perception and cognition per se (e.g., Abrams & Greenwald, 2000; Jacoby, 1998; Merikle & Daneman, 1998; Monahan, Murphy, & Zajonc, 2000) and others use these phenomena to investigate theories of personality, social psychology, psychopathology, and so on (e.g., Chen & Bargh, 1997; Glassman & Andersen, 1999; Patton, 1992; Waller & Mijatovich, 1998). The most generous estimates concerning the persistence of effects produced by subliminal means range from 30 minutes (Silverman, 1977) to small effects after 24 hours (Merikle & Daneman, 1998), but commonly effects are estimated to last up to 30 seconds at most (Draine & Greenwald, 1998; Velmans, 1991). Influential models of memory priming do not accommodate persistent effects of unconscious stimulation, instead predicting that the activation would dissipate (Bargh et al., 2001). There are demonstrations of unconscious activation of goal motivation lasting for perhaps five or ten minutes (Bargh et al., 2001; Shah, 2003a). The kind of persistence in question here however is complex effects, i.e. evidence of associative spreading activation, found days or weeks later.

Other findings reminiscent of persistent effects in the present sense have been reported, but they often include priming that only affects later processing of the priming stimulus itself, i.e. no spreading activation is evidenced. For example, if measured within 24 hours, reliable if small effects of words heard during general anesthesia were found, evidenced for instance in word stem completion (Merikle & Daneman, 1998). Also, in the Poetzl phenomenon, participants look at a picture of a natural scene for 100 ms, and are then asked to describe and draw everything they can remember about the picture. The following day, participants' recorded dreams have been shown to contain features of the picture not included in their drawings or descriptions (Shevrin & Luborsky, 1958). Both of these findings concern one-to-one priming, however, in addition to being of shorter duration than the effects in the studies I shall present.

In contrast, the SPA paradigm has yielded many observations that speak to the possibility of fairly long-lasting *complex* effects. For example, patients subliminally exposed to "mommy and I are one" prior to therapy sessions

showed better outcome (an original experiment and a successful replication can be found in Silverman, Martin, Ungaro, & Mendelsohn, 1978). This may be explainable in terms of more positive mood (Weinberger, 1992) which mediated outcome effects by affecting the interaction with the therapist, but positive mood may not be a likely main effect of MIO (Sohlberg, Billinghamurst et al., 1998; Sohlberg, Samuelberg, et al., 1998). Alternatively, increased affective activation or schema activation may have affected therapy, but no persistent effect of the stimulation itself would be implied. These accounts would instead for example be explainable in terms of facilitated encoding, such that therapy goals, exercises (the therapy was behavioral), and gains were better remembered. Another SPA study concerned memory effects a week after subliminal "mommy and I are one" stimulation, and the findings indicated individually different recall of performance on a task that participants completed in the laboratory a week earlier (Sohlberg & Jansson, 2002). Again, improved encoding of the task for some participants may explain those results, rather than true persistence of the activation. In these cases then, intervening factors are sufficient to explain the apparent persistence.

## Research Ethics and Subliminal Research

In my view, research use of unconscious manipulation, where the intent is to deny participants control of events, gives researchers the responsibility to design countermeasures. This applies whether or not persistent effects have been shown with a particular methodology. Researchers should both respect the autonomy of participants and guard against negative consequences of their research (Smith, 2000). In view of the present findings, a new look at what these ethical responsibilities entail may be needed in the context of unconscious stimulation.

Ethical recommendations detail how and what information should be provided to participants (e.g. APA, 2002; Sales & Folkman, 2000). The recommendations in question in the present context include *informed consent*, *dispensing with informed consent*, and *debriefing* (Standards 8.02, 8.05, and 8.08, APA, 2002). In studies on unconscious processes, truly informed consent can typically not be collected, which is justified in scientific or other ways, and instead the task of informing participants is deferred until debriefing. Whether debriefing is effective in removing the influence of unconscious stimulation has to my knowledge never been tested, however. This may be due to low motivation to research the issue, since the data relevant to

the research questions have been extracted before debriefing, and to the fact that truly long-term complex effects have not been demonstrated prior to the studies in this dissertation. Also, consensual persistence estimates of subliminal stimuli are low, and perhaps against this background, the few demonstrations of slightly longer effects do not seem to have triggered research into the effectiveness of debriefing (Bargh & Chartrand, 1999; Draine & Greenwald, 1998; Merikle & Daneman, 1998; Silverman, 1977; Velmans, 1991).

In a rare study, Ross, Lepper, and Hubbard (1975) showed that even entirely consciously experienced stimuli and manipulations can cause persistent effects that are difficult to dispel. Simple debriefing allowing for attribution of self-judgment bias did not prevent lingering effects in their study, and instead thorough information detailing also the mechanisms whereby effect persistence arose, and its possible negative impact, was required to normalize participants' responses. This latter kind of debriefing was theoretically guided, and may have been successful because of that. There is an important reason, however, for keeping theoretical explanations of a phenomenon separate from ethical attempts to counter the dangers associated with that phenomenon. Ethical principles and recommendations (e.g. APA, 2002) can only be general, in that they need to apply to a number of subject matters and methodologies. The purpose of research is usually to find specific explanations, however, and if the research cannot be performed without theoretically specific ethical safeguards, then it will not be performed. Since the methods used in research on unconscious processing are various, widespread, and successful, research using those methods will likely continue. A difficult future task, therefore, is to evaluate debriefing and other safeguards in order to ensure the well-being of participants, in spite of not having full knowledge of the phenomena under study.

## THE STUDIES

The studies concern persistent effects of subliminal stimulation. Study I attempts to establish whether such effects are real in five conceptually streamlined experiments more than a week after subliminal priming, with suggestive evidence also after four months in one experiment. The persistent effect findings consist of increased correlations between measures of psychological adjustment (e.g. depression) and measures of self-mother relationship quality in groups subliminally primed with "mommy and I are dissimilar" (MIDIS) or "mommy and I are one" (MIO), compared with control stimulation.

Study II tests whether two kinds of information to participants are successful in preventing persistent effects. Mimicking the types of debriefing interventions used by Ross et al. (1975), the information types include simply telling participants what they were exposed to subliminally (Experiment 1) and telling them also that this may lead to persistent effects, describing possible mechanisms, and stating that the information would help participants counteract the effects (Experiment 2).

In Study III, a theoretical account of persistent effects of unconscious stimulation is developed, in order to suggest general preconditions that may help researchers identify when special vigilance is warranted. The account centers on unconscious activation of motivation-laden memory that connects to cues in daily life.

## Method

Some features were common to all experiments. All experiments were between-groups designs, defined by what subliminal stimulus participants were exposed to, and in Study II also by which post-exposure information they received. Presentation of the subliminal stimuli was done in a dimly lit room by way of a tachistoscope with a contoured eyepiece connecting directly to a 80 X 55 mm screen onto which the text is projected at a virtual viewing dis-

tance of 600 mm. Eight exposures were used, which were 5 ms long and separated by 10 s, and experimenters were blind to which stimulus they presented to individual participants. Regular projection slides, on which the stimuli were written in one line ("people are walking" control stimulus) or two (other control and experimental mommy-stimuli), were used to present the stimuli. The laboratory session was individual for each person, and included subliminal exposures as well as subliminality checks. The latter included an open question as to what the participants had seen in the tachistoscope as well as an ascending threshold task where exposure time was gradually increased until participants reported seeing something structured (e.g. "a line"). Subliminality was in all cases acceptable. No participant was able to report having seen anything resembling the stimuli, and the lowest mean threshold was 30 ms (thresholds were typically between 100 and 200 ms).

Session 2 (questionnaire session) of each experiment occurred in groups in a lecture room approximately 7 to 14 days after subliminal exposures, except in Experiment 5 of Study I where participants completed the questionnaires at home. In that experiment also, pre-experimental baseline measures as well as 4-month follow-up data were collected. The questionnaires differed between experiments, and will be presented separately in the context of each study (see the Appendix for all descriptive dependent variable data).

## Participants

A total of 553 student volunteers participated in the 7 experiments (see Tables 1 and 2). Compensation was an open movie ticket except in Experiment 4 of Study I, where no compensation was given. Participant sex in each condition is listed only for Study II since this was not a factor in Study I. There were no significant age differences between groups in any experiment.

## Study I

*Experiment 1:* Seventy-four male participants were randomized to a "mommy and I are dissimilar" (MIDIS,  $n = 38$  "mamma och jag är olika" in Swedish) group or a "people are walking" (PAW,  $n = 36$  "folk promenerar" in Swedish) control group.

*Experiment 2:* Ninety-seven male participants were randomized to MIDIS ( $n = 35$ ), PAW ( $n = 30$ ) or "mommy and I are one" (MIO,  $n = 32$ , "mamma och jag är ett" in Swedish).

*Experiment 3:* Fifteen male and 25 female participants were randomized to MIO ( $n = 21$ ) or PAW ( $n = 19$ ).

*Experiment 4:* Fifty-nine male and 63 female participants were randomized to MIO ( $n = 29$ ), PAW ( $n = 31$ ), "one are and mommy I" (OMI,  $n = 30$ , "ett är och mamma jag" in Swedish) or "mommy ndi era rn oae" (M,  $n = 32$ , "mamma orä cht tg jea", in Swedish).

*Experiment 5:* Thirty-two male participants were randomized to MIO ( $n = 16$ ) or PAW ( $n = 16$ ). Thirteen in MIO (81 %) and ten in PAW (63 %) returned to take part at the four-month follow-up.

Table 1: Number of Participants in Each Experiment and Condition of Study I

	Exp. 1	Exp. 2	Exp. 3	Exp. 4	Exp. 5
People are walking (PAW)	36	30	19	31	16
Mommy and I are dissimilar (MIDIS)	38	35			
Mommy and I are one (MIO)		32	21	29	16
One are and mommy I (OMI)				30	
Mommy ndi era rn oae (M)				32	
Experiment total	74	97	40	122	32

## Study II

*Experiment 1:* Seventy participants were randomized to MIDIS ( $n=21$ , 7 male, 14 female, MIDIS exposure and no information), MIDIS Content ( $n= 25$ , 9 male, 16 female, MIDIS + Content information), or PAW ( $n= 24$ , 8 male, 16 female, PAW exposure and no information).

*Experiment 2:* One hundred and eighteen participants were randomized to MIDIS Irrelevant ( $n = 29$ , 10 male, 19 female, MIDIS + irrelevant information), MIDIS Process ( $n = 29$ , 12 male, 17 female, MIDIS + Process information), PAW Irrelevant ( $n = 34$ , 13 male, 21 female, PAW + irrelevant information), and PAW Process ( $n = 26$ , 12 male, 14 female, PAW + Process information).

Table 2: Number of Participants in Each Experiment and Condition of Study II

	Experiment 1		Experiment 2	
	Males	Females	Males	Females
PAW (Irrelevant)	8	16	13	21
PAW Process			12	14
MIDIS (Irrelevant)	7	14	10	19
MIDIS Content	9	16		
MIDIS Process			12	17
Experiment total	70		118	

## Statistical analysis

In all experiments, results consist of differences in correlations between groups. For example, correlations were computed separately for the groups between childhood memories of mother and current psychological adjustment. These correlations were then compared between groups, both in terms of significance and  $q$  effect sizes (i.e. the difference between  $z$ -transformed  $r$ s with the criteria small effect=.10, medium=.30, and large=.50, Cohen, 1988). Of interest will be not only generalizability of individual experiments, but recurring result patterns over the experiment series. At sample-level, this approach may lead to conclusions of effects even though significance is not reached. Bivariate outliers were observations with standardized regression residuals above 2.5 or below  $-2.5$  (StatSoft, 1994), which resulted in 0 to 5 outliers eliminated in each group and analysis. In a few cases, due to small samples, observations that had a disproportionate impact on the correlations (and were one standard deviation or more away from the remainder of their respective univariate distributions) were eliminated (cf. Edling & Hedström, 2003).

# STUDY I

The starting point of Study I was a reanalysis of an experiment (previously analyzed for short-term effects only), where complex, persistent effects of subliminal stimulation were found. Ten days after subliminal exposures, experimental participants' depression scores correlated more strongly with measures pertaining to their relationship with their mothers. That experiment was successfully replicated, and three others already carried out but not reported were also analyzed for persistent effects (except 4-month data in Experiment 5, which was collected as part of the present study). The experimental stimuli were “mommy and I are dissimilar” and “mommy and I are one”. In all experiments, effects consisted of changes in how measures of adjustment correlated with measures theoretically relating to a “self-with-mother” relational schema, or correlations between retrospective and current measures pertaining to such a schema.

## Experiment 1

### Measures

*The Self–Mother Similarity test.* Participants first rated themselves and then their mothers on each of 40 adjectives (e.g., “humoristic”, “dominant”, “outgoing”, “sad”; 1= adjective fits “a little”, 5= adjective fits “very well”). Similarity scores were calculated as Pearson correlations between self– and mother–ratings. This measure was created by S. Sohlberg and B. Jensen, and was first used in Sohlberg, Billinghamurst et al. (1998).

*SASB Intrex Relationship Long Form, first half (Structural Analysis of Social Behavior, Benjamin, 2000).* Participants rate on a 72–item scale (response scale is 0 to 100) the validity of statements about mothers' behavior toward them, and her response to their own behavior toward her, when they were 5 to 10 years old. The three variables of the “Disrupted Attachment Group”

part of the SASB model (Florsheim, Henry, & Benjamin, 1996) may relate to depression and were analyzed here for items relating to what the person remembers mother doing to him. *Ignore* represents negative undercontrol, *Attack* represents negative affiliation but is neutral in terms of control, and *Blame* represents negative overcontrol.

*The Beck Depression Inventory (BDI)*. One of the most widely used indices of depressive symptoms, Beck's Depression Inventory is useful in normal samples if scores are taken to indicate dysphoria rather than clinical depression (Beck & Steer, 1996; Beck, Steer, & Garbin, 1988).

## Results

Table 3 shows that Self-Mother Similarity (SMS) and depression (BDI) had 13 per cent variance in common in MIDIS ( $r = -.36$ ) but very little in PAW ( $r = .02$ ). The difference between these correlations was not significant but showed a medium  $q$  effect size of  $-.36$ .

Table 3 also shows with respect to SASB that in two out of three cases variables had more variance in common in the experimental group than in the control group. Thus, MIDIS was associated with a stronger correlation between depression and memories of mother as Ignoring ( $r = .34$  vs.  $.20$ , a "small"  $q = .15$  effect) as well as Blaming ( $r = .75$  vs.  $.37$ , a "large"  $q = .57$  effect,  $p < .05$ ).

Table 3: Experiment 1: Self-Mother Similarity and Memories of How Mother Acted (SASB), Both Related to Dysphoria (BDI). Table Shows Per Cent Variance Common to the Variables when Correlations were Computed Separately for the Experimental vs. Control Groups.

	MIDIS $n=38$	PAW $n=36$
SMS	13	0
SASB Blame	57	13
SASB Attack	2	2
SASB Ignore	11	4

## Discussion

Depression correlated more strongly with measures concerning the mother-relationship in the experiment group more than a week after subliminal exposures. The data did not seem to stem from methodological artifacts or simple mood change. The latter is so because one out of three SASB-BDI

correlations (*Attack*) did not follow a "sad — negative memories; happy — less negative memories" pattern in the MIDIS group. Instead, activation of some specific cognitive content was implied. Theoretical and ethical questions prompted a replication attempt, and a new experiment was performed that also included the phrase "mommy and I are one" (MIO).

## Experiment 2

### Measures

Measures were the same as in Experiment 1 except that one more questionnaire was added last in Session 2.

*The Hazan and Shaver retrospective attachment test.* From Hazan and Shaver's (1986) paragraphs, W. Friedlmeier developed thirteen items scored from 1 to 6 that retrospectively assessed Security (5 items), Ambivalence (3), and Avoidance (5) (translated to Swedish by P. Granqvist and B. Hagekull; Granqvist, 2002).

### Results

MIDIS correlations were higher than PAW on the same variables that showed this pattern in Experiment 1 as well as the new attachment measure, and MIO followed a similar pattern (Table 4). Experiment group correlations were in the expected direction, following a positive-associated-with-positive pattern, such that more negative memories were associated with higher BDI, for example. Effect sizes were small to large, and significance was obtained for three MIDIS vs. PAW comparisons (SMS, Secure, and Avoidant) and two MIO vs. PAW comparisons (SMS and Secure). The two experiment groups were not significantly different, but effect sizes for the differences were small to medium.

Table 4: Experiment 2: Self-Mother Similarity, Memories of How Mother Acted (SASB), and The Hazan and Shaver Attachment Measure, All Related to Dysphoria (BDI). Table Shows Per Cent Variance Common to the Variables when Correlations were Computed Separately for the Experimental vs. Control Groups.

	MIDIS <i>n</i> =35	MIO <i>n</i> =32	PAW <i>n</i> =30
SMS	46	18	0
SASB Blame	30	15	5
SASB Attack	1	13	1
SASB Ignore	13	16	0
Hazan & Shaver Secure	40	23	0
Hazan & Shaver Ambivalent	17	18	5
Hazan & Shaver Avoidant	27	16	1

## Discussion

Similar correlation differences were found here as in Experiment 1, and the MIO group followed suit, implying persistent effects of both subliminal experimental stimuli. The results were theoretically exciting but another replication was ethically problematic. Neither the informed consent nor the debriefing procedures referred to persistent effects, and given the evidence, they probably should at this point. However, alerting participants to that possibility may preclude the effects due to attributability (Bornstein, 1990, 1992). Two experiments that were only partially or not reported offered a solution (Experiments 3 and 4), as well as a third experiment run under different conditions (Experiment 5).

## Experiment 3

### Measures

Measures at Session 2 were the SMS test and the Hazan and Shaver attachment measure.

### Results

As shown in Table 5, SMS had more variance in common with the three attachment scales in MIO than in PAW (positive MIO correlation for Secure

and negative for the two insecure scales). The differences were not significant but effect sizes were small to medium.

Table 5: Experiment 3: Self-Mother Similarity Related to the Hazan and Shaver Attachment Measure. Table Shows Per Cent Variance Common to the Variables when Correlations were Computed Separately for the Experimental vs. Control Groups.

	MIO <i>n</i> =21	PAW <i>n</i> =19
Hazan & Shaver Secure Attachment	13	1
Hazan & Shaver Ambivalent Attachment	10	0
Hazan & Shaver Avoidant Attachment	3	0

## Discussion

A similar pattern was seen again in this experiment as before. Self-Mother Similarity and other measures that theoretically relate to a self-with-mother relational schema correlated more strongly in the experiment group.

In the following Experiment 4 MIO and PAW were used along with two more control stimuli: "one are and mommy I" (OMI, in Swedish "ett är och mamma jag") and "mommy ndi era rn oae" (M, in Swedish "mamma orä chtg jea"). This would help establish whether the entire syntax-dependent phrase was necessary for the effects or whether one or more words in jumbled order could also produce persistent effects. Dependent measures were Self-Mother Similarity and a measure of fear of intimacy in close relationships (Descutner & Thelen, 1991; Doi & Thelen, 1993), as well as Self-Father Similarity for control purposes.

## Experiment 4

### Measures

After having rated in Session 2 self and mother for the Self-Mother Similarity test, participants were given a third sheet and rated father also, enabling both Self-Mother Similarity and Self-Father Similarity (SFS) scores. Thelen's Fear of Intimacy Scale (FIS, Descutner & Thelen, 1991; Doi & Thelen, 1993) was administered, which measures fear of intimacy in close relationships with 35 items (scale 1 to 5).

## Results

As shown in Table 6, SMS and FIS shared more variance in the MIO group (negative correlation) than in the other groups, and more than SFS and FIS in MIO (this difference was significant at  $p < .01$ ). This suggests not only similar persistent effects as seen before, but that they are also dependent upon the whole phrase and specific to the self-mother relationship.

Table 6: Experiment 4: Self-Mother Similarity (SMS) and Self-Father Similarity (SFS) Related to Fear of Intimacy (FIS). Table Shows Per Cent Variance Common to Variables when Correlations were Computed Separately for the Experimental vs. Control Groups.

	MIO <i>n</i> = 29	PAW <i>n</i> = 31	OMI <i>n</i> = 30	M <i>n</i> = 32
SMS vs. FIS	38	7	0	1
SFS vs. FIS	1	5	1	1

## Discussion

In this experiment also, participants stimulated subliminally with a "mommy and I"–stimulus show higher correlations 7 to 14 days later between a measure pertaining to the self-mother relationship and a psychological adjustment measure. The effect also appears syntax–dependent and relationship-specific.

The smaller experiment 5, finally, was different from the other experiments in useful ways. First, participants rated depression and memories of mother already before coming to the laboratory, allowing baseline comparisons. Second, participants completed the 7-day questionnaires at home, which helped control for situational specificity in the effects. Third, participants at one point rated first their attachment styles in relation to other adults and then their level of depression. If the self–mother similarity questionnaire is a necessary reactivation cue with regard to the "mommy and I" comparison referred to in the subliminal phrases, no effects would be expected at that measurement occasion. Also, two tests in the laboratory related to an unconscious "self–with–mother" schema, enabling a check for effects occurring within minutes of the stimulation. Finally, a measurement session four months after the stimulation enabled analysis of very persistent effects. Because of small sample size and because the experimenter was no longer blind to group, these latter results must be viewed with caution.

## Experiment 5

### Method

#### **Design, Materials, and Procedure**

Data were collected on four separate occasions: *Pre-Stimulation*: Four questionnaires filled in at home, two of which were used in the previous experiments and were used now to examine the baseline equivalence of the groups (BDI and SASB Intrex).

*Session 1*: After stimulation with MIO or PAW, participants completed the EMT mood task (Weinberger et al., 1997) where they write brief notes for 4 min 30 s regarding childhood memories, and then rate these for emotional positivity on a scale from  $-7$  to  $+7$ . Mood is computed as the ratio between positive points and all points. Participants then did the Attachment Scripts Test (Gonzalez da Silva, Claesson, & Sohlberg, 1999), where participants select one out of three possible completions to 30 sentence stems (24 were used in analyses) reflecting Secure or Insecure (Ambivalent or Avoidant) attachment style. Scores are computed by counting the number of responses of each type. Participants then did the threshold task and were given questionnaires to fill in 7 to 10 days later at home, and to return by mail.

*Session 2 (at home)*: Participants completed the SMS test, a single-item version of the Hazan & Shaver attachment measure (which was dropped from analysis due to limited variance), and an Adult Attachment measure. This latter measure was created by Pehr Granqvist using the items in Collins and Read (1990) containing 6-item subscales for Secure, Ambivalent, and Avoidant attachment. Referred to as “ten day data” for short, the actual time range was 7 days to 4 weeks.

*Session 3*. Four months after Session 1 participants were invited back to fill in the Adult Attachment scale, the BDI, and the SMS test. Also, participants were interviewed (data not quantified) and debriefed, including discussion of persistent effects.

### Results

As shown in Table 7, the baseline data suggested no notable differences. Session 1 (10 minute) data were more reminiscent of the previous experi-

ments: mood and Secure Attachments Scripts had more variance in common in MIO than in PAW (a small effect size).

Ten days after stimulation there were large differences between groups in terms of SMS and adult attachment scale correlations (all significant and in the expected directions, mean  $q = .70$ ). Finally, after four months variables on average still had more variance in common in MIO than in PAW, but the differences were small and not significant (Table 7).

The BDI and the measure of adult attachment contained no references to "mother" and were administered before potential refresher cues. For these variables, MIO still had more variance in common than PAW in two out of three cases.

Table 7: Experiment 5, Baseline Pre-Stimulation Results, Ten-Minute Post Results, Ten-day Post Results, and Four-Month Post Results. Table Shows Per Cent Variance Common to Variables When Correlations Were Computed Separately for the Experimental vs. Control Group.

	<b>MIO</b> <i>n</i> = 16	<b>PAW</b> <i>n</i> = 16
<b>Baseline (at home)</b>		
SASB Blame and BDI	1	1
SASB Attack and BDI	3	1
SASB Ignore and BDI	0	4
<b>10-minute poststimulation (laboratory)</b>		
EMT mood and Secure Adult Attachment scripts	27	19
<b>10 days poststimulation (at home)</b>		
SMS and Secure Adult Attachment	52	2
SMS and Ambivalent Adult Attachment	52	1
SMS and Avoidant Adult Attachment	49	2
<b>4 months poststimulation (laboratory) *</b>		
Secure Adult Attachment and BDI	48	5
Ambivalent Adult Attachment and BDI	4	4
Avoidant Adult Attachment and BDI	45	35
SMS and BDI	23	40
SMS and Secure Adult Attachment	26	1
SMS and Ambivalent Adult Attachment	0	11
SMS and Avoidant Adult Attachment	12	2

\* Note: *n* at 4-month follow-up was MIO=13 and PAW=10.

## Discussion

Consistent with the previous experiments, variables correlated more strongly after MIO stimulation than after PAW throughout the experiment, whereas before stimulation they did not. The effect was stronger after ten days than after four months, implying that effects may recede with time. On the other hand, reanalysis of the ten-day data using only participants who took part at four months revealed a smaller difference between conditions already at that point (data not shown). Thus, effects at four months may not have come out weaker if the entire original sample had taken part. Also, refresher cues did not appear to be required for effects to occur. If situational cues were required, the effects found on measures filled in at home should not have occurred. If cues specifically relating to self-mother-comparison (as implied in the MIO phrase as well as in the SMS measure) were required, effects should have been found only when SMS was filled in first, which it was not at Session 3.

## Summary of Study I

In five experiments, correlations between Self-Mother Similarity and other measures were higher, after more than a week, in groups subliminally exposed to "mommy and I"-stimuli compared with control groups. This implies that complex effects of subliminal stimulation can be much more persistent than was previously assumed. Although significance was not always found, the pattern was repeated five times with different experimenters and participants, implying that the findings are reliable.

## STUDY II

Post-study information to research participants is generally assumed to remove effects (Stewart, 1992; Tesch, 1977). The hypothesis in Study II was therefore that results in groups given information would be different from those in an uninformed experiment group, but not from control group results. In Experiment 1, simple Content information was used, while more complex Process information was used in Experiment 2. As in Experiments 1 and 2 in Study I, the "mommy and I are dissimilar" (MIDIS) stimulus was used, as well as the same measures. Results were analyzed separately for men and women, since the MIDIS stimulus had previously not been used on females, and since differences between males and females using the "mommy and I are one" stimulus have been found (Sohlberg & Jansson, 2002). The MIO stimulus, also referring to "mommy and I", showed qualitatively similar effects to MIDIS in Experiment 2 of Study I, suggesting that sex specific results could occur with MIDIS also.

### Experiment 1

#### Method

Participants were seen in a "Session 1" and "Session 2" design identical to Study I. At the end of Session 1 the MIDIS Content group received a letter stating that they had been exposed to "Mommy and I are dissimilar", and containing contact information in case they needed to reschedule the next session. The other MIDIS groups and the PAW group were given letters containing the contact information only.

*Materials and Procedure, Session 2.* In the order presented during Session 2, the questionnaires were the Self–Mother Similarity Test (SMS), SASB Intrex Relationship Long Form, The Beck Depression Inventory (BDI), and the Hazan and Shaver Attachment Scale (Hazan & Shaver, 1986).

The variables that had shown persistent effects in Experiments 1 and 2 in Study I were used to form one factor by way of a Varimax-rotated Principal Components Analysis (Self-Mother Similarity, which was administered incorrectly to about half of the present sample, was not used). Included variables were the three subscales from the Hazan and Shaver Attachment Scale, and SASB clusters Blame and Ignore. Eigenvalue was 3.83, explaining 77% of the variance. Loadings were Avoidant .94, Secure —.87, Ambivalent .82, SASB Blame .84 and Ignore .90. The factor was called Retrospective Mother Relationship, and low scores represent positive memories of the relationship and high scores more negative ones.

After Session 2, a third session was added 2-5 days later, but some attrition in some already small groups prevented meaningful analyses of those data. At the end of this session, participants were given a full debriefing letter, and were urged to contact the head researchers if they had any questions about the experiment or wanted to further discuss their participation, which none of them did.

Significance tests of the differences were one-tailed for the research question concerning the effect of the information, and for the persistent effect for males. For females, no persistent effects have been reported for the MIDIS stimulus, and tests of the MIDIS (=MIDIS only) vs. PAW difference were therefore two-tailed.

## Results

### Males

The contrast between MIDIS and PAW among males showed a small difference of 23%—10%=13% shared variance ( $r$ 's were .48 and .31,  $q=.20$ ) consistent with the findings of higher experimental group correlations in Study I (Figure 1).

MIDIS compared with MIDIS Content yielded a similar difference (15%,  $r$ 's .48 and .28,  $q=.24$ ), while the MIDIS Content group was only slightly lower than PAW, with only 2% difference ( $r$ 's .28 and .31,  $q=—.03$ ). Descriptively then, the information did indeed have the expected normalizing effect. No differences were significant, however.<sup>3</sup>

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<sup>3</sup> Variable ranges, split by group and gender, were not significantly different, but ranges were smaller among male controls, which may suffice to explain the lower correlation in this

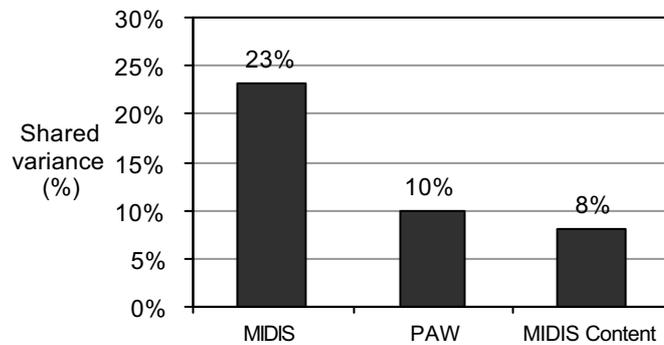


Figure 1. Shared variances among males in the three groups for the association between Retrospective Mother Relationship and the BDI in Experiment 1

## Females

In stark contrast to results among males, Figure 2 shows more shared variance in PAW than in MIDIS among females, a large difference of 46% shared variance ( $r$ 's  $-.15$  and  $.67$ ,  $q = -.96$ ,  $p = .02$ ). MIDIS compared with MIDIS Content also showed a large difference of 60% ( $r$ 's  $-.15$  and  $.76$ ,  $q = -1.15$ , one-tailed  $p = .002$ ), and PAW vs. MIDIS Content, finally, gave a smaller difference of 14% ( $r$ 's  $.67$  and  $.76$ ,  $q = .18$ , n.s.). The information appears to have had the effect that MIDIS Content was closer to PAW than to the MIDIS group, consistent with expectations.

## Males vs. females

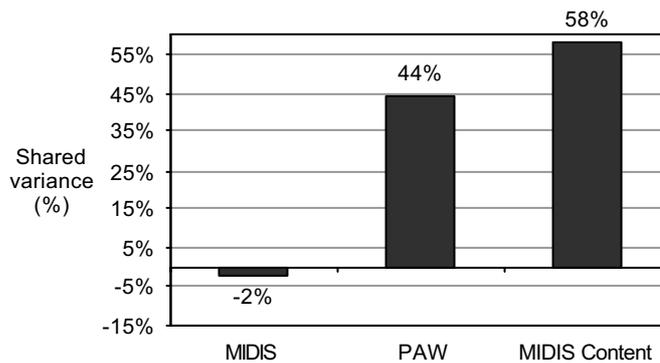
It was seen above that persistent effects of the MIDIS stimulus (MIDIS vs. PAW) among women consisted of lower correlations, rather than higher as for males. Contrasting males' and females'  $p$ -values for that comparison to yield the complete pattern of sex X stimulation interaction resulted in a marginally significant  $p = .06$  (two-tailed) using Rosenthal's (1984) Formula 4.1.

Investigating MIDIS Content vs. MIDIS in the same way yielded  $p = .04$ , showing that males and females responded significantly differently to the information after receiving MIDIS stimulation. However, the putative normalizing effect of the information was not significantly different for men and

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group. Note however that in Experiments 1 and 2 of Study 1 ( $N = 74$  and  $65$ ) showing the same kind correlation difference, range differences were unable to account for results.

women,  $p = .25$ . The information appears to have worked in opposite directions to fairly well counteract the opposite effects of the MIDIS stimulus.



*Figure 2.* Shared variances among females in the three groups for the association between Retrospective Mother Relationship and the BDI in Experiment 1 (below zero means that the association between variables was negative).

## Discussion

The MIDIS Content intervention appears to have worked in the hypothesized direction for both sexes. The MIDIS group was different from both MIDIS Content and PAW results, while the latter were closer to each other. Among males, effects were small and not significant, but the pattern is consistent with Study I. Among females, effects were larger.

The results also suggest an important addition to the findings in Study I, namely that persistent effects of MIDIS in females are opposite in direction compared with males.

Experiment 1 concerned the simplest possible type of information, and in Experiment 2 richer information was tested. Describing the possible mechanisms behind persistent effects modeled on Baldwin's (1992) relational schema concept, this information was given to one MIDIS group called MIDIS Process. An additional PAW group was also given MIDIS-appropriate information and called PAW Process. This deception enabled evaluation of the effects of the information only. Two further groups, one MIDIS (MIDIS Irrelevant) and one PAW (PAW Irrelevant), were given

information that was irrelevant in content but similar in length and complexity.

## Experiment 2

### Method

*Materials and procedure.* The information letter contained a three-question quiz task included to aid and check participants' comprehension. Participants read the letter and answered the questions in another room and placed the sealed envelope in a container. This procedure restricted variation in the amount of rehearsal of the information.

The *Process* letter contained the MIDIS phrase, and stated that this had previously produced persistent effects such that well being was more related to memories of the relationship with mother, which was described as an important formative relationship. Possible mechanisms for the effects were a) increased attention toward aspects of behavior in other people that were typical to how they related to mother, b) such schema-consistent behavior would seem more important, and c) they might themselves tend to elicit such behaviors from people they interacted with. It was stated that these effects were undesirable but that the information could help counteract them. The irrelevant letter given to the MIDIS Irrelevant group and the PAW Irrelevant group was similar in length and amount of information but concerned altered perception of unspecified environmental stimuli.

The second session took place on average 8 days later (range 6-15) and included the same four questionnaires as in Experiment 1. Factor analysis yielded one factor (Retrospective Mother Relationship) with Eigenvalue 3.45 that explained 69% of the variance, with loadings of Avoidant .87, Secure — .90, Ambivalent .77, SASB Blame .72, and Ignore .87. Low scores again represent positive memories of the relationship and high scores more negative ones.

## Results

### Males

The persistent effect pattern was reproduced in males, with a large difference of 26% ( $r$ 's .40 and  $-.31$ ,  $q=.74$ ,  $p=.07$ , one-tailed), but the MIDIS Process group was only slightly different from MIDIS Irrelevant (6%,  $r$ 's .30 and .40,  $q=.12$ ). MIDIS Process differed substantially from PAW Irrelevant (19% difference,  $r$ 's .30 and  $-.31$ ,  $q=.63$ ,  $p=.09$ , two-tailed). While descriptively in the right direction, the information was not successful at normalizing participants (see Figure 3).<sup>4</sup>

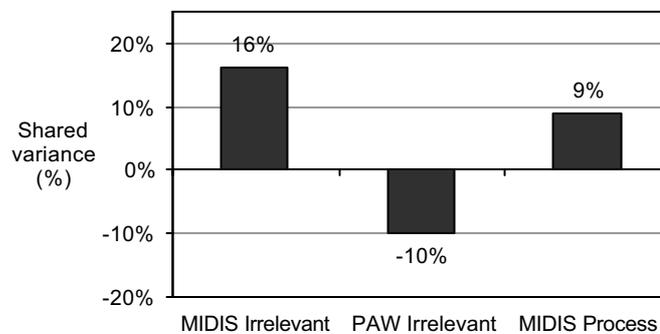


Figure 3. Shared variances among males in the four groups for the association between Retrospective Mother Relationship and the BDI in Experiment 2 (note that PAW Process is not included in the figure)

Interestingly, PAW Process showed the largest correlation (60% shared variance,  $r=.77$ ) and was significantly different from PAW Irrelevant ( $q=1.34$ ,  $p=.002$ , two-tailed) with a large difference of 70%. It therefore appeared that the information alone can give persistent effects.

### Females

Among females, as in Experiment 1, the persistent effect was in the opposite direction compared with males, with a large and significant (33% difference,

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<sup>4</sup> A caveat is in order concerning the *PAW Irrelevant* result. An inverse relationship between depressiveness and negative memories of the relationship with mother is inconsistent with the results of Experiment 1, as well as with control group results in Study 1. Setting the *PAW Irrelevant* correlation to a compromise 0, the result pattern (including subsequent analyses) is less clear but qualitatively similar.

$r$ 's .10 and .57,  $q = -.63$ ,  $p = .03$ , two-tailed) difference between MIDIS Irrelevant and PAW Irrelevant (Figure 4). MIDIS Process compared with MIDIS Irrelevant however yielded only a small difference ( $r$ 's .26 and .10, 7%,  $q = -.24$ ), and PAW Irrelevant vs. MIDIS Process showed a medium effect (26% difference,  $r$ 's .57 and .26,  $q = -.40$ ). While in the right direction, the information thus did not normalize participants here either.

Finally, the PAW Process result (27% shared variance,  $r = .52$ ), was not meaningfully different from PAW Irrelevant (6% difference,  $q = .09$ ,  $p = .82$ , two-tailed), showing that the process information alone did not have a substantial effect for females.

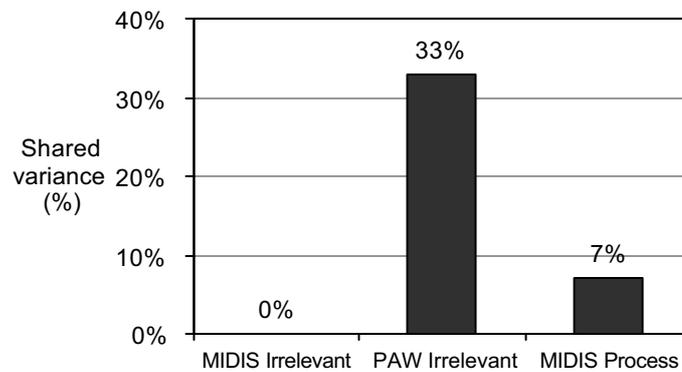


Figure 4. Shared variances among males in the four groups for the association between Retrospective Mother Relationship and the BDI in Experiment 2 (note that PAW Process is not included in the figure).

### Males vs. females

Testing, as in Experiment 1, the complete pattern of sex X stimulation results for the MIDIS Irrelevant vs. PAW Irrelevant comparison yielded  $p = .003$  (two-tailed). Further, the contrast between males' and females'  $p$ -values for the MIDIS Process vs. MIDIS Irrelevant contrast showed no significance:  $p = .54$ , two-tailed. Instead, the difference between males' and females'  $p$ -values for the MIDIS Process vs. PAW Irrelevant contrast was significant at  $p = .05$ , two-tailed. Thus, men and women were significantly different even after information, as were those who did not receive information.

## Discussion

Persistent effects were found again, similar to Experiment 1. The kind of information used in Experiment 2 was less effective in preventing these effects, however. Sex differences were also found again in the direction of the persistent effects. Informing participants who had been exposed to PAW that they had been exposed to MIDIS, further, appeared to produce persistent effects among men but not among women.

## Combining Results across Experiments

Combining results across experiments in order to stabilize estimates appeared warranted for the basic MIDIS vs. PAW contrast (i.e. groups not receiving relevant debriefing information). For men, this yielded  $p=.10$  (Formula 4.9, Rosenthal, 1984), showing marginally significant support for persistent effects among men, consistent with Study I. For women, a combined  $p$  of .003 was found, showing that correlations in the experiment groups decreased significantly compared with the control groups. Combining the sex X stimulation interactions for the *MIDIS* vs. *PAW* contrast across experiments yielded  $p = .0004$  (two-tailed), showing that men and women respond significantly differently to the MIDIS stimulation.

## Summary of Study II

It appeared that the simple information used in Experiment 1 worked better towards normalizing results, while the Experiment 2 groups that received information were closer to the MIDIS Irrelevant groups, implying less beneficial effects of the more elaborate information used there.

A general conclusion from this study could be that some debriefing is better than none: all groups receiving MIDIS + information showed smaller effects than those receiving MIDIS only. Beyond this however, the pattern suggested that simple Content information in Experiment 1 worked better than the Process information in Experiment 2.

It is unclear why the simple information in Experiment 1 should prove more successful at preventing persistent effects. Read consciously, the significance of the MIDIS phrase is probably not clear to participants, and deactivating the associations it gives rise to when administered subliminally

should require more elaborate information. Instead we found that elaborate information was relatively ineffective, and indeed caused persistent effects of its own in the PAW Process condition among males. This may be due to an "ironic effect", where a suggestion not to be affected by a cognition instead increases its accessibility and thus increases its influence (Wegner, 1994). Another suggestion might be that while *ruminatio*n is associated with psychological problems, *reflectio*n is not (Trapnell & Campbell, 1999), and perhaps the brief information invited reflection while the Process letter in Experiment 2 led to activation-sustaining rumination.

It is unclear also why the Self-Mother Similarity measure was involved in the result pattern in Study I but did not figure in the Retrospective Mother Relationship factor in Experiment 2, thus not appearing to measure the same construct. The obvious difference between SMS and the other measures is that SMS is not explicitly retrospective while the others are. In Study I however, persistent effect correlations were found that included Self-Mother Similarity and, for example, the Hazan and Shaver attachment measure. More research is needed to clarify the key differences between Self-mother similarity and the other measures used in Studies I and II.

Across experiments, a clear and significant difference between women and men in response to MIDIS was found, a contrast not investigated before. While the results for men were fairly weak, they are more compelling in light of Study I. This kind of persistent effect could be interpreted as an effect of activating a self-mother relational schema, which then becomes more influential in social processing and behavior and thus has a stronger influence on well being. The inverse result pattern found among women could result from a similar mechanism as among men, that is, increased accessibility of the self-mother relational schema leading to intrusions of this schema into conscious thought and behavior. Given the relatively high degree of naturally occurring correlation between the self-mother relational schema and well being, as seen in the control groups, the conscious awareness might lead women to attempt to consciously avoid this influence in the service of (presumably desired) further differentiation from mother. Relatedly, the finding that PAW Process (i.e. neutral stimulus but MIDIS information) affected men but not women could suggest that for women, accessibility of the self-mother relational schema was already so high that no ironic effect ensued. Among men, on the other hand, for whom the information had greater news value, an ironic effect may have occurred.

In summary, simply telling participants in subliminal experiments what they were exposed to seems more effective in preventing persistent effects than

also telling them the specifics of what this may lead to. This is true in both men and women despite the fact that the sexes showed different kinds of persistent effects.

## STUDY III

The purpose of Study III was to present a general model for persistent complex effects of unconscious stimulation, centering on unconscious activation of motivation-laden memory that connects to cues in daily life. While influence from cues that are not consciously noticed is probably an everyday occurrence, research manipulations achieve this with focus, control, and accuracy, and researchers need to know when to be vigilant toward ethically problematic lasting effects that participants have no control over.

A brief restatement of the issues covered in the Introduction to this dissertation that specifically touch upon this theoretical account will follow. The model will then be presented, along with necessary qualifications, an illustrative example, and research implications.

Subliminal stimuli disallow attribution to an external source and instead function as part of one's normal, subjectively unbiased attitudes, judgments, motivations, and so forth. It is also possible to influence people outside their conscious attention by, for example, having stimuli merely appear unrelated to a present task. Various methods can be used to activate high-order processes such as affect regulation (Davidson, 1999; Westen, 1999), goal pursuit (Bargh & Ferguson, 2000), and transference leading to self-fulfilling prophecies (Andersen & Chen, 2002; Chen & Bargh, 1997).

### Automaticity and the Environment

Automatic information processing serves the purpose of increasing adaptation by fitting behavior to the currently most important environmental features, where that importance is determined by internal needs or motivations. Phenomena become subject to conscious processing if and when automatic affective, motivational, or cognitive processes make us notice them (Baars et al., 1997; LeDoux, 1996). This means that the currently most important features of the environment will tend to be noticed, and affective and motiva-

tional factors organize processing resources and memory formation around relevant domains (Bower, 1992; LeDoux, 1996; Lewis, 1996; Lewis & Granic, 1999; Nathanson, 1996). Westen (1999) states that "Just as a schema or network can be activated in a priming study, leading to a pattern of inference, interpretation or expectation in line with activated cognitive contents, so, too, can situations that resemble prior situations in some way (such as interactions with authority figures), prime particular interpretations, expectations, affects, fears, wishes, defenses, behaviors and so forth" (p. 742).

## Motivation as an Organizer of Memory

Organized memory structures have been given many names, for example associative networks, scripts, and schemas. In the present context structures where motivation acts as a cohesive force and contain goal representations are of interest, for convenience termed *schemas*. Motivation, which I propose is required for persistent effects, has the important feature of remaining active or even growing in strength in spite of delays and in the face of obstacles until the goal is reached by some appropriate available means (Bargh et al, 2001; Shah, 2003a). Motivation can be activated automatically by environmental cues, and until the goal has been fulfilled it stays active. I concentrate on attachment-related schemas, because in people's lives probably the single most important factor, and source of motivation-related memory, is other people. Many researchers investigate such schemas using unconscious priming, and persistent effects of such manipulations are an ethical concern.

So far, persistent effects have been found using tachistoscope methodology, as described in Studies I and II. These effects were assumed to be due to activation of a relational schema.

## Explaining Persistent Effects of Unconscious Stimulation

I now present the explanatory model and its mechanisms, followed by a hypothetical example of how persistent effects might arise and unfold.

## Unattributable Motivated Maintenance and Interactive Maintenance

When a schema containing motivation is activated by primes whose existence or significance goes unrealized, the increased influence of that schema is not consciously attributable to an external source. Vigilance is increased toward features that represent means to fulfilling the motivation, and the motivation is sustained, or even increases, until it has been fulfilled. I call this mechanism *motivated maintenance* of the activation. The activation may subside under one of three conditions. First, if suitable attribution of the activation origin is possible, that is, the person is made aware of the unconscious influence and what has caused it, choosing not to pursue the goal may be possible. Second, if the activated goal is attained, the motivation will subside since it is no longer necessary. Third, if the environment contains no features even distantly associated with the goal, the motivation does not connect with general adaptation needs and becomes irrelevant.

If this third condition is not met, i.e. there are cues in the environment that correspond to the schema, attention is guided toward them and away from others. This vigilance will cause such matching cues to be noticed more often and when noticed they will appear more important. The person will also expect such cues and will therefore be biased to perceive and judge such cues to be present in ambiguous or near-matching stimuli. The person will also through schema-consistent behavior invite such cues, such as inviting certain behavior from others, or more often seeking out certain situations. By these means, the activation of the schema and the goal motivation will be reinforced. This mechanism I call *interactive maintenance* of the activation.

Interactive and motivated maintenance are both required for persistent effects. Unless the unconscious stimulus refers to something motivating, the stimulus will not *activate* anything. Instead the effect dissipates and does not result in vigilance toward environmental cues. The organism can relax because nothing important, such as danger, is signaled. Interactive maintenance, in turn, requires at least some brief activation persistence in order to come into effect, and such brief persistence has been demonstrated in the context of unconscious goal activation (Bargh & Chartrand, 1999). Cues associated with the activated network must also appear in the environment, otherwise the activation is again predicted to dissipate. If nothing in the environment reminds the organism of the possible presence of an important influence, or no possibility for attaining an unconscious goal is evident, there is no adaptive value in heightened alertness.

An important implication is that if this activation does not subside because the goal is not met or through other means, the schema-related biases and behaviors should result in new associative contingency learning. That, in a sense, would make the activation permanent, because its increased influence is incorporated into everyday behavior.

### An Interpersonal Example

An interpersonal example could look as follows. Participants in a social cognition experiment are exposed, via a computer, to the masked stimulus series "mother", "criticism", "excluded", "scold", and "worthless", perhaps several times and in different order. The most organized set of memories containing the strongest affect will likely be the most strongly activated part of the network. For different people, associations may be different. For some, the activated memories may, predictably, concern interactions with mother revolving around being criticized and scolded, leading to feelings of being excluded from mother's love and of being worthless. For other participants, the associations may revolve around experiences of criticism from mother, but from there associations will lead to experiences of love, support, and non-judgmental guidance, which work as internalized affect regulation tools that defend against the anxiety of the memories of criticism. The goal here may be, again, to avoid criticism and ensure mother's continued love. People's schemas surrounding important life issues are differently organized and rely on different experiences, and the objects of vigilance will therefore be individually different. Identifiable individual difference variables (such as attachment style) determine whether the first or second type of associations will predominate.

Attributing the activation to an external source is not possible for participants, and so the activated schemas can do what schemas do, namely guide perception and behavior in schema-consistent directions. For participants with the negative core schema, this will entail seeing criticism in others more often and experiencing it as more unpleasant, which factors will maintain the activation of the core schema. They will also expect criticism from others, and doing so they will unconsciously invite it, by subtly acting in ways that others are likely to criticize. Until the goal is reached, and in the absence of attribution of the unconscious influence which could lead to being able to discard the goal, the influence will continue if environmental cues are sufficiently often relevant to the schema and its goals. The effects are subtle in each situation, which decreases the likelihood that other people will react openly to this alteration in behavior, and instead they react in the normal

automatic way, reinforcing the activation. The reactivated schema will then lead to learning.

## The Empirical Persistent Effect Findings Revisited

Using this theoretical account, the findings of Studies I and II may be explained. The effects were interpreted as indicating activation of a self-mother relational schema, which caused that schema to influence participants daily lives to a greater extent; adjustment was more affected by experiences in relation to mother. The suggestion was that the tachistoscopic exposures activated a structure that was once influential but is not currently so in participants.

For some participants, associations centered on a schema concerned with negative experiences, insufficient protection, inadequate love, and lack of support. These individuals would then more often tend to notice, be disturbed by, and invite such behaviors in others. The goal to attain mother's sensitive care and love, and to avoid its opposite, would thus transfer to persons and situations presenting relevant cues, but the goal would not be attained because it is unrealistic and concerns a situation that is no longer present. For other participants, the schema contained expectations of support, acceptance, and interpersonal closeness. For all participants, feelings of well being would tend to conform to their interpersonal experiences over time, and depending on the quality of memories contained in the schema, this could for instance mean higher or lower depressiveness, respectively.

## Researching the Model

Conducting research on this model would include systematically varying the presence or absence of factors of motivation and interaction. The empirical examples I have been considering concern significant-other representations, and I have outlined reasons to believe that persistent effects are likely when that type of structure is targeted. Other sources of motivation than attachment, however, are candidate domains according to the model. Using, for the moment, the arbitrary example of physical danger, subliminal stimuli alluding to injury or a neutral domain such as furniture, and matching interaction conditions (e.g. memorizing either injury types or manufacturing materials), would produce persistent effects only in the danger + injuries condition.

Individual differences surrounding important domains may be expected, making simple main effects less likely, and impose limitations on what types of stimuli might produce persistent effects in which populations. Stimuli referring to the example above, for example, may have that property only for people who have had frequent experiences with injury, and whose adjustment has become profoundly affected by this. For some, associations may be predominantly negative and include feelings of insecurity and fear. For others, associations may be influenced by experiences of security and support. Further, the above design but using *supraliminal* activation stimuli would produce no long-term effects, since attributability of the danger influence would obviate any such strengthening of domain relevance.

## Concluding Comments

Besides raising questions as well as answering some, the presented model carries an important implication. Persistent effects of unconscious stimuli are not only possible but also not even very difficult to produce. Researchers need to be vigilant toward the possibility that their participants are left with more than they signed up for, and debriefing procedures need to be evaluated. On the other hand, with a high level of ethical sensitivity, research may be able to capitalize on persistent effects to answer important questions about unconscious processing.

## SUPPLEMENTARY ANALYSES

### A Test of the If-Then Aspect of Relational Schema Scripts

In Study III, as well as in the previous studies, I assumed and argued that the persistent effects were due to the activation of a relational schema. An additional set of analyses may at this point help ascertain whether this assumption is valid. Recall that the interpersonal script in relational schemas (i.e. habitual ways of behaving in the relationship) is organized as if-then-contingencies (Baldwin, 1992, 1999; Chen, 2003). Returning to the data from Study I, an additional and face-valid way to evaluate this aspect of relational schemas in relation to MIO stimulation was available in Experiment 5 data. In Experiment 5 analyses, the focus was exclusively on concurrent measures in order to investigate changes in how the measures related to one another in relation to the introduction of the subliminal exposures. Prediction from one measurement occasion to another however was not performed, but such analyses may be useful here. The Attachment Scripts Test (Gonzalez da Silva et al., 1999) items used in the laboratory session of Experiment 5 had an explicit if-then design, where participants could choose one of three completions to a statement. Correlations between the AST and EMT Positivity of Childhood Memories showed the expected higher correlation in MIO than PAW in Study I, but relating the AST not to a content-free mood measure but a measure of memories of mother would constitute a more focused test of the relational schema interpretation. The SASB memories of mother measure was included in baseline data taken at home before the laboratory session. If a relational schema was activated by MIO as opposed to PAW, there should be a difference between groups in how SASB predicted AST responses. The AST did not concern mother but current, adult expectations of other people in general when the participant was in some distress, therefore theoretically related to how mother treated participants.

Using ranked SASB data (sample sizes were small, and SASB data is often non-normal on the analyzed variables), I correlated the combined AST Insecurity scale (laboratory) with the three SASB variables *Blame*, *Attack*, and *Ignore* (baseline at home before the laboratory session). Results showed a clear pattern, such that in the PAW ( $n=16$ ) control group, explained variances between the AST and the three SASB variables were 4%, 1%, and 5%, respectively (all negative correlations). The corresponding MIO ( $n=16$ ) results were 54%, 33%, and 32%, and the  $q$  effect sizes for the differences between MIO and PAW were all large and significant (all positive, i.e. negativity in memories of mother were associated with more insecurity in if-then expectations; tests are two-tailed due to post-hoc nature of the analysis): 1.13 ( $p=.002$ ), .75 ( $p=.05$ ), and .85 ( $p=.03$ ), respectively. This is additional evidence that MIO produces effects that would be expected if a self-mother relational schema was activated, namely attachment-related changes in if-then contingency expectations as moderated by memories of how mother behaved during childhood. Thus, such changes may be a contributing cause of persistent effects.

## Investigating a Control Group Inconsistency

An inconsistency in the data across Studies I and II concerns female control group results. For males, the pattern appeared consistent that "mommy and I"-stimulation resulted in higher correlations between measures than after control stimulation. For females, Study II instead showed lower correlations after "mommy and I are dissimilar" than in the control group, which showed correlations of .67 and .57, respectively. However, in Study I, Experiments 3 and 4 were carried out on mixed samples consisting of a slightly higher proportion females, and correlations in the control groups in those experiments were weak (unweighted mean  $r=.14$ ). Therefore, I performed a reanalysis of those data separately for men and women. Tables 8a, 8b, and 9 show the resulting shared variances, with minus signs added in order to show direction of effect. Outliers were identified and eliminated as before.

Looking at male results in Table 8a, the reanalyzed Experiment 3 data show a similar pattern to that found among males in all of the other experiments, namely that correlations in the control group were weaker than in the experimental group. For females also (Table 8b), control group correlations in two out of three comparisons were stronger than in the experimental group, which is consistent with Study II. The control groups in Experiment 3 when split by participant sex, then, were similar to the control results in Study II.

The pattern also implies that "mommy and I are one" may be associated with a similar sex difference as the MIDIS stimulus.

Table 8a: Experiment 3 Males (Study I): Shared Variances between Self-Mother Similarity and the Three Subscales of the Hazan and Shaver Attachment Measure.

Self-Mother Similarity vs.	MIO ( $n=8$ )	PAW ( $n=7$ )
Hazan & Shaver Secure	31	—3
Hazan & Shaver Ambivalent	—38	—4
Hazan & Shaver Avoidant	—36	—6

Table 8b: Experiment 3 Females (Study I): Shared Variances between Self-Mother Similarity and the Three Subscales of the Hazan and Shaver Attachment Measure.

Self-Mother Similarity vs.	MIO ( $n=13$ )	PAW ( $n=12$ )
Hazan & Shaver Secure	0	10
Hazan & Shaver Ambivalent	0	0
Hazan & Shaver Avoidant	2	—24

Table 9 shows a different picture, however (I have left out the OMI and M conditions since the other studies concern the contrast between a "mommy and I" stimulus and the "people are walking" control only). Study I Experiment 4 data do not appear to follow the same sex-specific pattern of the other experiments. Instead, the male PAW correlation is higher than the male MIO correlation, such that a higher degree of similarity with mother was associated with less Fear of Intimacy than in MIO. For females, a higher degree of similarity with mother was associated with less Fear of Intimacy in the MIO condition than in the PAW group.

Table 9: Shared Variances between Fear of Intimacy and Self-Mother Similarity in Experiment 4 of Study I, Split by Sex.

	MIO ( $n=14/15$ )	PAW ( $n=15/16$ )
Male	8 <sup>5</sup>	—18
Female	—64	0

Importantly, these analyses are post-hoc, and the cell sizes are fairly small when split by sex. Therefore, the results should be viewed with caution. However, the Experiment 3 reanalysis is consistent with the other experiments regarding males, and for females, results are consistent with Study II female results. Experiment 4 results imply that Fear of Intimacy may differ from the Hazan and Shaver measure with respect to persistent effects of MIO, as moderated by participant sex.

<sup>5</sup> Besides one formal bivariate outlier, one observation was eliminated that had an disproportionate impact on the result and was  $-1.6$  *sd* from the mean in the male MIO group. With this observation included, explained variance in this cell was  $-6\%$ .

Note that neither of the above reanalyses of Study I data alter the conclusion that "mommy and I" –stimuli can produce persistent effects. Rather, the sex difference found in Study II is indirectly supported, in that the MIO stimulus also appears to be associated with sex differences in results. In summary, males responded with increased correlations after MIO and MIDIS, with the exception of Self-Mother Similarity vs. Fear of Intimacy. Females on the other hand responded with decreased correlations after MIO and MIDIS, with the exception of Self-Mother Similarity vs. Fear of Intimacy. Further comments concerning interpretations of this pattern are offered below.

## Overall Effect Estimation

In order to get an overall estimate of the magnitude of persistent effects, and in order to judge their reliability, averaging the effects across studies would be helpful. Both the MIDIS and MIO stimuli were used together in only one experiment, but highly similar results were produced by both across experiments in comparison with the PAW control stimulus. Similarities included the qualitative difference between men and women and the fact that experiment 4 of Study I did not show the same direction of effects. Results were therefore averaged across both "mommy and I" (MI) conditions in this analysis. I chose to use the correlation coefficient effect size, weighted by degrees of freedom, which can then be compared with empirical guidelines for interpreting the magnitude of correlation coefficients, based on 380 meta-analytic assessment and treatment studies (Hemphill, 2003). Two analyses will be presented, based on how the anomalous Self-Mother Similarity vs. Fear of Intimacy results in Experiment 4 of Study I are viewed. First, Experiment 4 results may represent a failure to produce persistent effects of the kind shown in the other experiments; namely higher correlations between measures at 10-day measurement in men but decreased correlations in women. If viewed this way, one out of seven experiments for males and one out of three experiments for females yielded effect estimates that did not conform to the expected pattern. The experiment 4 results are then included in the mean effect estimate.

I calculated the mean correlation for MI groups (weighted by  $n-3$ ) and compared it with the corresponding weighted PAW mean correlation. The resulting weighted mean  $q$  correlation difference (i.e. difference between  $z$ -transformed  $r$ s) I converted back to  $r$ , which I then compared with Hemphill's (2003) guidelines:  $<.2$  (representing the lower third of the distribution of correlation coefficients in the examined studies),  $.2$  to  $.3$  (middle third),

and  $>.3$  (upper third). For males, the overall effect size estimate for MI across seven experiments is then  $r=.32$  (upper third compared with Hemhill's 2003 guidelines), based on an average weighted shared variance of 20% in male MI groups ( $n=160$ ) compared with 2% in PAW ( $n=121$ ).<sup>6</sup> The corresponding figure for female participants was .19 (lower third of effects), based on 8% shared variance in MI female groups ( $n=61$ ) and 19% in PAW ( $n=65$ ). Thus, even if Experiment 4 of Study I is considered a failure to produce persistent effects, MI halved the association between measures for females compared to PAW, and the effect was close to the middle third of published findings. For males, MI stimulation increased the association between measures tenfold, and the overall effect was substantial compared with published findings. The overall data pattern therefore still points to persistent effects of "mommy and I" stimuli, and that these effects are qualitatively different depending on participant sex.

Viewed another way, Experiment 4 was the only experiment to include Fear of Intimacy, and it was also the only experiment where the sex-specific results came out differently. If viewed as a non-random result, the implication would be that while the Fear of Intimacy variable does produce persistent effects that are different for men and women, the direction of effect is different from that observed with the other variables. Future research that focuses on the theoretical nature of kinds of persistent effects may reproduce and help explain this observation, but further speculation is not warranted here. The overall effect estimates based on exclusion of Experiment 4 data was, for males,  $r=.42$  (upper third), based on 25% mean shared variance in MI ( $n=146$ ) and 1% in PAW ( $n=110$ ). For females, the figure is  $r=.54$  (upper third), based on 0% mean shared variance in MI ( $n=46$ ) and 30% in PAW ( $n=49$ ).

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<sup>6</sup> Excepting SASB *Attack* in Study I since this variable was not included in Study II.

## GENERAL DISCUSSION

In seven experiments, evidence was found of over week-long effects of subliminal stimuli. The experiments were similar in that the same two experimental stimuli were used. This limits the external validity of the findings, and more research is needed to ascertain whether persistent effects can be produced also by way of other stimuli and in the context of other psychological domains than the self-mother relationship. However, the findings appear reliable, since the pattern of experimental group vs. control group differences was repeated in at least six and possibly seven of the seven experiments where investigation of such effects was possible. In addition, the effects were sometimes substantial, as shown by the overall effect estimates calculated above and compared with Hemphill's (2003) empirical guidelines. From other research, correlations between Self-Mother Similarity and the BDI offer points of comparison (Sohlberg, Stahlheuer, & Tell, 1997). Results from that study showed that among normal student males ( $n=86$ ), the correlation was  $-.24$  (6% shared variance), whereas among student females ( $n=107$ ) the correlation was  $-.45$  (20% shared variance). Thus, the finding from the present studies' control groups that baseline association levels are different among men and women, and higher among women, receive support from research also targeting students. In the all-male Experiment 5 of Study I also, baseline (pre-laboratory) data showed that correlations were low, consistent with the conclusion that MIO and MIDIS increase a normally low level of association.

In rough summary then, in seven out of seven experiments effects were produced by subliminal stimulation that were measurable about ten days later, and the effect magnitudes were among the top 33% in psychological research for males, and similar or slightly smaller for females depending on cross-experiment estimation procedure. Such a conclusion may appear somewhat amazing at first glance. However, I have tried to point to some factors that detract from the mysterious quality of the findings. These include the fact that the content of the exposures was in fact unconscious, which made the activation unattributable to an external source and disabled conscious inhibitory control. Also, while the exposures were weak, the stim-

uli referred to factors that are anything but weak, namely the most important early attachment relationship that the majority of humans encounter. The motivation and memories surrounding this relationship then influenced everyday life in such a way as to sustain the activation. Whether the account presented in Study III is accurate is for future research to decide, but the statement is already warranted that previous authoritative assumptions (e.g. Draine & Greenwald, 1998; Velmans, 1991) concerning the longevity of subliminal stimulation effects need revision.

The experiments were conceptually streamlined in that all the data pertained to mood, personality, and mother. Concerning the stimuli, effects of MIDIS and MIO did not differ significantly in Experiment 2 of Study I, and instead overall showed similar effects as compared with stimuli either not containing the words "mommy and I" at all, or containing them in scrambled order. The medium effect sizes found between MIO and MIDIS in Experiment 2 may indicate that reliable differences could be found in future experimentation employing more theoretically focused measures. For present purposes, however, it appears that the present results may be examples of a more general class of "mommy and I"-effects as opposed to other stimulus classes, for example social categories.

One difference between MIO and MIDIS is worthy of note, however. A specific correlation pattern was found in the MIDIS groups in Experiments 1 and 2 concerning SASB vs. BDI (where Blame and Ignore but not Attack showed persistent effects), but not in the MIO group in Experiment 2. This suggests that simple mood change, which also appears insufficient to explain even short-term data, was not responsible for the persistent effects (e.g. Siegel & Weinberger 1998; Sohlberg et al., 2000). Instead, consistent with previous theory and data the activation of a relational schema is implied (Sohlberg & Jansson, 2002, cf. Baldwin, 1999), where dysphoric affect was associatively linked more to the perception of some maternal actions than to other maternal actions.

## Are Relational Schemas Responsible for the Persistent Effects?

I argued above for the persistent effects being the result of the activation of a relational schema, by citing for example memory effects and category activation as a result of MIO (Sohlberg et al., 1997; Sohlberg & Jansson, 2002). Suggestive of such activation is also the specificity in the altered correlation

patterns in Experiment 2 of Study I, i.e. the difference between SASB *Ignore* and *Blame* on the one hand, and *Attack* on the other as a result of MIDIS but not MIO. The supplemental analysis of Experiment 5 data from Study I showed that the activation produced responses consistent with the relational schema model, adding further evidence for the hypothesis that relational schema activation is responsible. Although additional direct tests of this hypothesis are necessary, the present evidence implies that future research may benefit from extra vigilance when relational schemas are investigated by subliminal or unobtrusive means. This may be especially true when schemas concerning significant others and attachment motivation are in question, as per the hypothesis from Study III that motivation-laden schema activation is necessary for such effects. Fitzsimmons and Bargh (2003) demonstrated unconscious activation of interpersonal goals in relation to friends and mother, by activating the relational schemas containing those goals. That is, relational schemas involve goal motivation, and activation of motivation, in turn, is especially likely to be persistent, as argued previously (Bargh et al., 2001; Fitzsimmons & Bargh, 2003).

Speculatively, perhaps structural changes, e.g. correlation changes and not level changes in single variables, are consistent with the idea of relational schema activation. The specific content of relational schemas is subject to individual differences, and their if-then structure should perhaps lead to an alignment of well-being, mood, and adaptation to the contents of the schema. This would mean that at group level, simple changes in for instance depression would not be expected, but rather individually different responses as a result of the individually different ways in which schema-consistent expectations, evaluations, etc., affect the participant. The opposing expectations "*If I am in trouble then someone will help me*" and "*If I am in trouble then I will be ignored*", would tend at least over time to have different consequences for the respective participants harboring them. This speculation may aid future research in detecting persistent effects that might otherwise go unnoticed. It is important, further, to note that other schemas than social ones may produce persistent effects, and, considering the apparent empirical equivalence between different ways of activating unconscious processing (Bargh & Chartrand, 1999), persistent effects may obtain also with other means of rendering a manipulation opaque to participants. Vigilance toward these possibilities should be maintained.

## The Power of Debriefing

The hypotheses in Study II are incompletely evaluated. Analyses in the two experiments were based on small cell sizes and the post-exposure information to participants was not the same in both experiments. While the results were suggestive, and similar across men and women in spite of the fact that among women the persistent effects showed up as smaller MIDIS than PAW correlations rather than the reverse, the ability for debriefing-type interventions to prevent persistent effects must be further studied. This is an area of inquiry that has been seriously neglected, albeit understandably so. However, persistent effects may be possible also in the context of other kinds of schematic memory than attachment representations, for example stereotypes. Stereotypic judgements and behaviors in relation to other people appear fairly easy to produce using unconscious stimulation, and a wide range of effects have been observed of such activation (Wheeler & Petty, 2001). Lingering effects of stereotype activation in research would perhaps represent a more striking ethical problem than the present findings. Research into persistent stereotype effects could, depending on the results, defuse fears of this possibility or increase motivation to deal with the ethics of subliminal stimulation in a more comprehensive way. Both outcomes would be highly relevant.

In a comprehensive theoretical review of automatic bias, Wilson and Brekke (1994) argued that it is difficult for individuals to control such bias, since many kinds of conscious knowledge are needed. These include the presence, size, and direction of effects, as well as the motivation and ability to correct the bias. Such insights have yet to be applied to the problem of debriefing in subliminal stimulation studies. The central conclusion from the present studies must therefore be in the form of an appeal for concentrated efforts to improve knowledge concerning participant welfare in the expanding field of studies using unconscious stimulation procedures.

## Sex Differences

The most notable finding in Study II involved differences between men and women, which was found to be stable across experiments. The reanalyses of Study I data from the mixed-sex Experiment 3 and 4 samples also showed qualitative sex differences, such that the experimental-control differences

were opposite for men and women. Sex differences in *short-term* response to "mommy and I are one" have been found before but judged to be small in comparison with the similarities in reaction between men and women (Sohlberg & Jansson, 2002). An implication of the present findings is that sex differences may increase over time, and that vigilance toward also this variable may increase the chances of identifying persistent effects that may otherwise be obscured. In other areas of unconscious stimulation research, sex differences have been neglected as a possibility, only to recently be uncovered (Ekehammar et al., 2003).

Concerning reasons for the sex differences, a few considerations were forwarded in the summary of Study II above. Centering on heightened accessibility of the self-mother relational schema, I suggested that among males, naturally occurring accessibility of this schema is low (as seen in the low control group correlations), and the effect of MI stimulation is to increase this influence. Among females, MI stimulation was introduced under different conditions, in that an already high accessibility level (as seen in the high control group correlations) appeared to be present. Consistent with this idea, in longitudinal research, Buist, Dekovic, Meeus, and van Aaken (2002) found a higher quality attachment relationship with mother among girls than among boys (while the inverse is true for attachment to father). Also, attachment changes during adolescence were different according to sex, such that the quality of attachment to same-sex parents decreased gradually, while quality of attachment to opposite-sex parents decreased more rapidly in early adolescence. In parallel, those authors argued, conflict within same-sex child-parent attachment dyads increases during adolescence. In the present mother-related context, males would according to these observations have experienced a rapid decrease in attachment quality with regard to mother in early adolescence, suggesting a higher degree of resulting differentiation. Females, however, would have experienced a more gradual decline and corresponding conflict increase, leading to higher active involvement in and negotiation of the self-mother relationship in early adulthood. Other authors have also proposed such later separation from mother among females (Carlberg, 1989; Cramer, 2000).

Returning to the present case, MI stimulation may for males have activated a relational schema that was not normally as influential in their lives as among females since they had achieved a higher degree of differentiation from mother than the female participants had. Their relational schemas being less accessible to start with, male participants did not recognize the effects of this increased accessibility. Instead they would unconsciously tend to more often tend to interpret events, pursue goals, and behave in ways consistent with the

schema. For females on the other hand, the active nature of the self-mother differentiation process would entail a high baseline degree of accessibility in the relational schema. The additional increase due to MI stimulation may have led to intrusions of that schema influence into consciousness more often, resulting in cognitions such as "I'm behaving just like my mother", or "My friend is treating me just like my mother does". Female participants' better ability to identify the influence may have helped them avoid it in the service of continued differentiation. This may be reminiscent of a "contrast effect" as seen in stereotype research (Wheeler & Petty, 2001). A contrast effect is when responses to stereotype activation are inconsistent with the stereotype, for example increased politeness following activation of a stereotype associated with hostility. In the studies in Wheeler and Petty's (2001) review, contrast effects were only seen with conscious stereotype primes, while unconscious priming only led to assimilation effects (responses consistent with the stereotype). In the present case, a higher degree of consciousness of persistent influence effects could lead to contrast effects in women, while the more unconscious effects among men lead to assimilation and schema-consistent behavior. While post-hoc, these speculations may point to predictions concerning the content nature of persistent effects, as well as implying that a sex-specific inverse pattern might be expected if the subliminal stimuli were "daddy and I are one" and "daddy and I are dissimilar".

Another difference in results concerned the effect of the fake MIDIS-appropriate debriefing letter given to participants who had received PAW stimulation. Males showed a strong persistent effect of this letter, but females did not. Research on thought suppression has tended to show a robust "ironic" or "rebound" effect, making the to-be-suppressed contents more accessible (Rassin, Merckelbach, & Muris, 2000). Dovetailing the above suggestions concerning sex differences of unconscious MI stimulation, males may have experienced an ironic effect of the instruction in the letter to avoid the influence, due to the low level of normal accessibility of the self-mother relational schema. Females, on the other hand, were already aware of the possibility for influence from the mother-relationship described in the letter, and may thus not have suffered additional ironic effects as a result of trying to avoid the influence.

## Limitations of the Findings and Remaining Questions

An important limitation of the present studies is that all participants were university students, and three of the experiments had only male participants.

While all humans may be subject to persistent effects of subliminal stimuli, some caveats should be outlined. In addition to the sex difference discussed above, the student participants were typically around 22-23 years of age, and the present findings may not apply to other age groups. Other sources of homogeneity are for example educational level and ethnicity, all of which may moderate the kind and expression of persistent effects of subliminal stimuli, at least when less universal themes than maternal attachment are in question.

Further, the results in Studies I and II were not individually significant in some cases. While vital in the assessment of individual experiments, this fact is not a problem given the consistency of the result pattern across studies, including the qualitative gender differences. It is clear however that several experiments had insufficient power for the present hypotheses and statistical tests, a point worthy of attention in possible replication attempts. As concerns the measures, correlations between measures of mother and adjustment measures were prioritized, since a correlation effect involving measures pertaining to the self-mother relationship on the one hand and those not pertaining to it on the other appeared to persuasively show that persistent complex effects were indeed produced. In all experiments, those analyses were chosen out of those available that would constitute the best test of complex effects, represented for example by measuring different construct domains, such as memories of mother and current depression.

The exception to this rule was Experiment 3 in Study I, where SMS was correlated with the retrospective attachment measure. Based on the first two experiments in Study I, SMS appeared to tap the self-mother relational schema similarly to the other mother-related measures, and in Experiment 3 only two mother-measures were available, and correlations between these seemed a possible way to index relational schema activation effects. Study II results implied, however, that SMS may in fact differ from the other measures. The SMS measure is, beyond measuring current as opposed to retrospective representations, qualitatively different in that it concerns profile similarity rather than the validity of simple statements. It therefore remains unclear how SMS factors into the persistent effects in terms of its association with other mother-related measures, and it may not be as interchangeable with the other measures as it once appeared to be. A more cautious summary could thus be that in six out of six experiments across Studies I and II, correlations between mother-measures and measures of adjustment differed between experimental and control groups, rather than seven out of seven experiments showing the same persistent effect pattern.

It is important also to note that the 5-ms exposures as well as the exposures included in the threshold task took place during the same laboratory session and thus together form the stimulation package. The threshold exposures, thus, may factor into the effects seen ten days later, and the fact that the thresholds were part of the exposure package does mean that the number of exposures was not constant between individuals. Note however that on the threshold task, the experimenter asked and recorded what the participant saw after each exposure, and no participant reported reading any part of the stimulus but only, at most, reported seeing "a line", "maybe some text" or similar statements. Thus, even the longest threshold exposures conform to the present requirement for subliminality: lack of reportability of stimulus content. The validity of participant's reports at the threshold task could be called into question, with reference to the possibility that participants were reluctant to report seeing emotional or "hot" stimuli. This argument is reminiscent of the "taboo word" issue, which concerned the idea that participants may have higher recognition thresholds for  $\alpha$  be reluctant to report seeing for instance profanity or sexual words (Loftus & Klinger, 1992). Both the latter possibility and the different thresholds between individuals would be serious problems if the thresholds differed substantially and reliably between conditions in the experiments, but they did not.

A difference between Studies I and II is that thresholds were generally lower in Study II (group means in Study I ranged from 70 to 458 ms and in Study II from 30 to 73 ms). Another difference between Studies I and II was that in Study I, all mother-measures appeared logically to target the same construct (consistent pattern across experiments), whereas in the Study II factor analyses there was a split between the retrospective and the present-day measures. Logically, the threshold difference between the studies may be related to the difference in coherence among measures. Many definitional subdivisions in the area of unconscious perception and cognition are falling into disuse in favor of the less stringent criterion of lack of reportability of stimulus content (or stimulus impact, i.e., priming without understanding), especially in social cognition and personality research. Perhaps, however, the degree of subliminality can moderate the kind of persistent effects that are produced. Speculatively, exposures closer to conscious awareness may activate contents closer to everyday consciousness, as exemplified by the present-day SMS measure, which factored into effects in Study I where longer exposures were used during the threshold task. In Study II, the threshold task was halted at shorter exposures durations, possibly due to more stringent criteria used by the experimenters, and SMS did not factor into the persistent effects. Only childhood memories did, which presumably figure less in daily awareness. Research varying the duration of exposures, using for example five ms

up to 300 ms in one condition and five ms up to for instance 50 ms in another, could investigate whether correlation effects involving SMS and, for example, the BDI obtain only for the 300 ms condition, which longer duration would presumably render the stimulus closer to awareness.

## Subliminal vs. Supraliminal Stimulation

The stimuli here were subliminal, but what if supraliminal stimulation yields similar effects? While unlikely (Bornstein, 1990, 1992), it is perhaps possible that some persistent effects may come about using conscious stimulation. In Study II, Experiment 2, the *Process Control* group was given neutral exposures but also the information letter stating that they had subliminally been exposed to "mommy and I are dissimilar", and detailing the possible persistent effects of that. To the extent that that letter may be seen as an analogue of the MIDIS stimulus, it appears that persistent effects are possible among males using that kind of supraliminal stimulation. The male *Process Control* correlation was high compared with both *Control* and the group that was exposed to MIDIS but that did not receive the MIDIS information. For females however, no effect of the fake information was apparent, but at the same time, subliminal stimulation effects did occur for females in the *No Information* group compared with *Control*. Thus, the sex difference observed as a result of subliminal stimulation was not reproduced in the fake information condition, indicating a difference between supraliminal and subliminal stimulation.

Most importantly, the present conclusion of persistent effects of subliminal stimuli would not be affected by a finding of persistent effects of consciously attended stimuli. Nor would such a finding be inconsistent with present models in cognition, emotion, and personality, whereas the present findings are more of a challenge. Instead, an implication of persistent effects of conscious stimuli would be that conscious debriefing information in psychological research might not be as effective as might be wished.

## Final Remarks

In 1977, Silverman wrote a paper on the ethics of unconscious priming, concluding that since effects could last no longer than 15 or 30 minutes at most, persistence was not a serious concern. This time estimate should in view of

the present discussion be changed to 'indefinite' and efforts to investigate the scope and pervasiveness of subliminal activation are called for. Researchers using unconscious stimulation, especially when investigating personally significant phenomena, may do well to evaluate whether they are in danger of producing persistent effects, and if so, whether their ethical safeguards are sufficient.

## APPENDIX

Below follow tables containing descriptive statistics for the dependent variables in Studies I and II, as well as participant age in Study I (except Experiment 1 where age data is missing). The statistics (except age) are presented in variable pairs, since bivariate outliers are sometimes different depending on which variable combination is being considered. Means and standard deviations for each dependent variable is thus reported for the data underlying each correlation in Studies I and II. Note that for Study I Experiment 5, only baseline and 10-day poststimulation data are included, since 10-min and 4-month analyses do not pertain directly to the conclusion.

Theoretical ranges for the measures are SASB 0 to 100 (Tables i, ii, and v), BDI 0 to 63 (Tables i, ii, v, vi, and vii), Hazan & Shaver Attachment 1 to 6 (Tables ii and iii), SMS (and SFS)  $-1$  to  $1$  (Tables i, ii, iii, iv, and v), FIS 1 to 5 (Table iv), Adult Attachment 6 to 36 (Table v), Retrospective Mother Relationship factor scores ranged from  $-0.96$  to  $4.63$  (Table vi) and  $-1.36$  to  $4.10$  (Table vii).

Table i: Study I, Experiment 1

	MIDIS <i>m (sd)</i>	PAW <i>m (sd)</i>
SMS	.25 (.302)	.37 (.247)
vs.		
BDI	6.1 (4.51)	4.6 (3.64)
SASB Blame	5.9 (7.58)	6.6 (6.83)
vs.		
BDI	6.9 (5.28)	4.6 (3.64)
SASB Attack	4.8 (7.35)	4.2 (5.23)
vs.		
BDI	6.1 (4.51)	4.6 (3.64)
SASB Ignore	6.6 (9.21)	4.8 (5.88)
vs.		
BDI	5.7 (4.01)	4.6 (3.64)

## Appendix

Table ii: Study I, Experiment 2

	MIDIS <i>m (sd)</i>	MIO <i>m (sd)</i>	PAW <i>m (sd)</i>
Age	23.3 (3.12)	23.5 (2.94)	21.9 (1.98)
SMS vs. BDI	.31 (.304) 3.7 (2.91)	.25 (.296) 4.9 (3.34)	.22 (.311) 7.0 (4.92)
SASB Blame vs. BDI	5.7 (7.48) 3.7 (2.91)	9.8 (3.33) 5.9 (4.60)	7.8 (7.52) 7.0 (4.92)
SASB Attack vs. BDI	3.3 (3.67) 3.2 (2.39)	8.9 (15.46) 5.9 (4.60)	6.3 (5.04) 7.0 (4.92)
SASB Ignore vs. BDI	4.0 (7.49) 3.7 (2.91)	13.2 (20.67) 5.9 (4.60)	7.9 (9.23) 7.0 (4.92)
Hazan & Shaver Secure Attachment vs. BDI	4.7 (.89) 3.7 (2.91)	4.4 (.95) 5.9 (4.60)	4.6 (.71) 7.0 (4.92)
Hazan & Shaver Ambivalent Attachment vs. BDI	2.3 (.98) 3.7 (2.91)	2.7 (1.23) 5.5 (3.88)	2.7 (1.3) 7.0 (4.92)
Hazan & Shaver Avoidant Attachment vs. BDI	1.6 (.62) 3.7 (2.91)	2.0 (.98) 5.9 (4.60)	1.8 (.77) 7.0 (4.92)

Table iii: Study I, Experiment 3

	MIO <i>m (sd)</i>	PAW <i>m (sd)</i>
Age	24.0 (5.15)	21.5 (2.09)
Hazan & Shaver Secure Attachment vs. SMS	4.4 (.85) .24 (.256)	4.2 (1.13) .26 (.292)
Hazan & Shaver Ambivalent Attachment vs. SMS	2.5 (1.33) .24 (.256)	2.2 (1.03) .26 (.292)
Hazan & Shaver Avoidant Attachment vs. SMS	1.6 (.13) .24 (.256)	1.7 (.63) .28 (.272)

## Appendix

Table iv: Study I, Experiment 4

	MIO <i>m (sd)</i>	PAW <i>m (sd)</i>	OMI <i>m (sd)</i>	M <i>m (sd)</i>
Age	25.5 (7.27)	24.1 (4.52)	23.5 (3.18)	23.2 (3.64)
SMS vs. FIS	.19 (.336) 1.9 (.44)	.31 (.350) 2.2 (.53)	.37 (.328) 2.1 (.48)	.31 (.243) 2.2 (.50)
SFS vs. FIS	.28 (.253) 2.0 (.54)	.30 (.289) 2.2 (.526)	.32 (.342) 2.1 (.48)	.30 (.269) 2.2 (.50)

Table v: Study I, Experiment 5

	MIO <i>m (sd)</i>	PAW <i>m (sd)</i>
Age	26.1 (6.88)	24.2 (2.32)
<b>Baseline (at home)</b>		
	9.8 (9.70)	6.4 (7.48)
SASB Blame vs. BDI	5.4 (4.46)	6.2 (4.39)
SASB Attack vs. BDI	4.4 (4.01) 5.2 (4.52)	6.3 (5.48) 6.0 (4.37)
SASB Ignore vs. BDI	8.7 (10.26) 5.4 (4.46)	3.5 (4.40) 7.7 (5.63)
<b>10 days poststimulation (at home)</b>		
	.44 (.328)	.31 (.123)
SMS vs. Secure Adult Attachment	23.5 (5.06)	24.2 (4.28)
SMS vs. Ambivalent Adult Attachment	.44 (.328) 18.5 (6.66)	.31 (.123) 13.8 (3.98)
SMS vs. Avoidant Adult Attachment	.44 (.328) 16.4 (8.60)	.31 (.123) 15.8 (6.14)

## Appendix

Table vi: Study II, Experiment 1

	MIDIS $m$ ( $sd$ )	PAW $m$ ( $sd$ )	MIDIS Content $m$ ( $sd$ )
<b>Males</b>			
Retrospective Mother Relationship	.28 (.970)	— .48 (.279)	— .21 (.489)
<b>vs.</b>			
BDI	7.6 (7.31)	3.1 (3.08)	4.8 (3.58)
<b>Females</b>			
Retrospective Mother Relationship	.27 (1.309)	— .52 (.783)	.56 (1.532)
<b>vs.</b>			
BDI	7.4 (4.90)	6.9 (2.93)	6.8 (4.66)

Table vii: Study II, Experiment 2

	MIDIS Irrelevant $m$ ( $sd$ )	PAW Irrelevant $m$ ( $sd$ )	MIDIS Process $m$ ( $sd$ )	PAW Process $m$ ( $sd$ )
<b>Males</b>				
Retrospective Mother Relationship	.09 (1.08)	— .06 (.621)	.30 (.903)	— .07 (.787)
<b>vs.</b>				
BDI	4.1 (3.93)	5.0 (5.34)	6.1 (3.87)	4.9 (5.61)
<b>Females</b>				
Retrospective Mother Relationship	.05 (1.381)	— .38 (.699)	.18 (1.263)	— .03 (.908)
<b>vs.</b>				
BDI	4.8 (3.09)	6.3 (3.20)	4.1 (3.52)	6.4 (6.78)

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