

The man who wasn't there: Subliminal social comparison standards influence self-evaluation[☆]

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Abstract

Life provides an endless stream of social comparison information. Because opportunities to compare with others are so abundant, social comparison theory traditionally assumes that people are selective in their comparison activities and primarily compare with deliberately selected standards. Recent research, however, demonstrates that social comparisons often occur spontaneously, even if no standard is explicitly provided or deliberately selected. We examined whether comparisons are so spontaneous that they are even engaged if people are fleetingly exposed to a potential standard—so fleetingly that they remain unaware of the standard. In three studies, participants were subliminally primed with moderate versus extreme, high versus low standards during self-evaluation. Results demonstrate that self-evaluations are influenced by subliminally presented standards. Specifically, self-evaluations are assimilated towards moderate standards and contrasted away from extreme standards. These self-evaluative consequences of subliminal standards, however, were only obtained if participants engaged in self-reflection during standard exposure. These findings emphasize that social comparisons are truly ubiquitous processes that are engaged even for fleeting exposure to standard information.

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In their daily routines, people are constantly confronted with information about the abilities, fortunes, and weaknesses of others. In fact, life provides such an endless stream of social comparison opportunities that people may have a hard time to relate all of this information to themselves. It is thus little surprising that one of the cornerstones of social comparison theory and research is the notion that people are selective in their social comparison activities (Festinger, 1954). People are

not assumed to compare themselves with any potential standard. Rather, they are taken to select those standards for comparison that promise to provide valuable information because they are similar to the self (Festinger, 1954; Goethals & Darley, 1977; Miller, 1982; Suls, Gastorf, & Lawhon, 1978; Wheeler, 1966). Social comparisons are thus typically seen as involving a deliberate standard selection process in which different standards are considered and the most appropriate one is selected. Supplementing this traditional view, recent research suggests that comparisons may not always be deliberate processes that are strategically engaged. Oftentimes, social comparisons simply happen. In fact, people spontaneously compare themselves even with clearly irrelevant standards (Gilbert, Giesler, & Morris, 1995). This suggests that social comparisons may be so natural and effortless that they are carried out even if the comparison offers little valuable information.

What are the limits of this inclination to spontaneously compare with others? Are potential standards already used for comparison, if social judges are only fleetingly exposed to them? Imagine, for example, that

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while reflecting on your athletic abilities on your way to the gym you hear somebody mention the name of Michael Jordan? Does such a fleeting exposure to a potential comparison standard influence self-evaluations of your athletic abilities? In the present research, we pushed this question a little further and examined whether a standard to whom exposure was so fleeting that—phenomenologically—he was not even there, is used for comparison. Do people compare themselves with a standard who was not consciously perceived because he was presented outside of awareness? To find out, we subliminally primed participants who were engaging in self-evaluation with the names of potential social comparison standards. If such subliminal standards are indeed used for comparison, then this would be apparent in an influence on subsequent self-evaluations. Comparisons with others change the way we see and evaluate ourselves (Morse & Gergen, 1970) so that changes in self-evaluation can be used as an indicator of social comparison activities.

In fact, the direction of these self-evaluative comparison consequences appears to be highly variable in that sometimes self-evaluations are assimilated toward a given standard and sometimes they are contrasted away from the standard (e.g., Brewer & Weber, 1994; Brown, Novick, Lord, & Richards, 1992; Buunk, Collins, Taylor, VanYperen, & Dakof, 1990; Lockwood & Kunda, 1997; Mussweiler & Bodenhausen, 2002; Pelham & Wachsmuth, 1995; for an overview and theoretical integration, see Mussweiler, 2003). One of the critical moderators that determine whether assimilation or contrast results as a comparison consequence, is standard extremity. We have recently demonstrated that in deliberate social comparison self-evaluations are assimilated towards explicitly provided moderate standards and contrasted away from extreme standards (Mussweiler, Rüter, & Epstude, in press). This is the case, because for both types of standards people seek and activate different subsets of self-knowledge during the comparison process (Mussweiler, 2003). Comparisons with moderate standards involve a comparison process of similarity testing which increases the accessibility of knowledge indicating that self and standard are similar. In comparing their athletic abilities to a moderate standard like Bill Clinton, for example, participants consider the possibility that they are as athletic as the former US president and selectively search for information that is consistent with this assumption. Comparisons with extreme standards, however, involve a comparison process of dissimilarity testing which increases the accessibility of knowledge indicating that self and standard are different. In comparing their athletic abilities to an extreme standard like Michael Jordan, for example, considering the possibility that one may be as athletic as the former basketball professional makes little sense, so that people instead selectively search for

information indicating that their athletic ability is different from Michael Jordan. Consistent with this assumption, we have recently demonstrated that judges assimilated self-evaluations of their athletic abilities to the moderate standard Bill Clinton, and contrasted away from the extreme standard Michael Jordan (Mussweiler et al., in press). As is true for social judgment in general (e.g., Herr, 1986), self-evaluations were thus assimilated to moderate standards and contrasted away from extreme standards. Would this influence of standard extremity on the direction of comparison consequences also hold for subliminal standards? We examined these questions in three experiments. Studies 1 and 3 focus on the effects of moderate subliminal standards. Study 2 examines the effects of moderate and extreme standards.

Study 1

If subliminally presented standards are used for social comparison, then this would be apparent in their influence on subsequent self-evaluations. Comparisons with moderate standards typically yield assimilative self-evaluative consequences, so that the self is evaluated to be higher on the critical dimension after a comparison with a moderately high rather than a moderately low standard (see, Mussweiler, 2003; Mussweiler et al., in press; Mussweiler & Strack, 2000). In Study 1, participants were subliminally primed with either a moderately high or low standard of aggressiveness while evaluating themselves on this dimension.

Method

Participants

We recruited 32 students at the University of Würzburg as participants. They were contacted over phone, asked to participate in a series of unrelated experimental studies that would last for a total of 1 h, and offered a compensation of Euro 6.

Materials and procedure

Upon arrival in the lab, participants were led to individual booths and seated in front of computer monitors. Instructions informed them that their task was to engage in a series of self-evaluations. Specifically, they would be asked to evaluate their aggressiveness by making a series of judgments. Before making these judgments they were instructed to first reflect on their aggressiveness and consider how aggressive they were for about 1 min. To ostensibly help them concentrate on this question, we instructed participants to focus their attention on a letter string that was presented in the center of the screen. This fixation string was presented for 3000 ms and was replaced by the name of the social

comparison standard that was presented for 15 ms and immediately masked by the same letter string that was again presented for 3000 ms. This sequence was repeated 10 times, so that participants were subliminally exposed to the potential comparison standard 10 times, while reflecting on their aggressiveness for about 1 min. Half of the participants were exposed to the name of a moderately high standard of aggressiveness (the German TV-detective Schimanski), the other half with a moderately low standard (the German pop-singer Guildo Horn). Both standards were pretested in a separate study in which 21 participants rated the aggressiveness of themselves and a series of potential standards on a 9-point scale (1 = not at all aggressive, 9 = very aggressive). Based on the results of this pretest, moderate standards were selected so that the mean self-rating ($M = 3.2$) was in between mean ratings for the moderately low ($M = 2.2$) and the moderately high standard ($M = 5.4$).

After the priming task, participants proceeded with a series of self-evaluative judgments. Previous research has demonstrated that “objective” (Biernat, Manis, & Nelson, 1991) or absolute judgments allow for a less biased assessment that more directly reflects the representational consequences of comparison (Mussweiler & Strack, 2000) than “subjective” (Biernat et al., 1991) or dimensional judgments (for a more elaborate discussion, see Mussweiler, 2003). Using such absolute judgments, participants were asked to imagine that they got into a fight with a friend and to estimate the likelihood (%) that they would engage in each of the following aggressive behaviors: calling names, insulting, and getting physically violent. For example, participants gave their best percentage estimate of the likelihood that they would insult their friend.

We used a funneled debriefing method to test for participants’ awareness of the primes (Bargh, Chen, & Burrows, 1996). Participants answered a series of seven awareness check questions which progressively revealed the true nature of the priming task: (1) *Did you notice anything special in this study?*, (2) *What do you think this study was about?*, (3) *Did you notice anything special with the fixation string?*, (4) *Did you notice that presentation of this letter string was interrupted?*, (5) *Do you have any idea of what the interruptions consisted?*, (6) *In fact, the fixation letter string was interrupted by the very brief presentation of words. Were you able to detect these words?*, and (7) *Please write down the words you detected.*

Results and discussion

Analyses of the awareness check questions revealed that none of the participants were skeptical about the procedure, inferred the actual purpose of the study, or were able to report the standard names that were presented. One participant indicated that the fixation string

may have been interrupted by the presentation of another word but was unable to name the word. Because it is not entirely clear whether for this participant, the standard remained subliminal, we excluded her from further analyses.

We z -transformed answers to the self-evaluative judgments and averaged them into one aggressiveness score (*Cronbach’s* $\alpha = .85$).

We expected self-evaluations to be assimilated towards the subliminally presented comparison standards. In light of our previous research demonstrating that deliberate comparisons with explicitly provided moderate standards yield assimilative self-evaluative consequences, we expected the same to be true for subliminal standards. Our results are consistent with these expectations. Indeed, self-evaluations were assimilated towards the subliminally presented comparison standards: participants presented with the high standard evaluated themselves to be more aggressive ($M = .32$), than those presented with the low standard ($M = -.30$),¹ $t(29) = 2.1, p < .05$ (two-tailed).

These findings demonstrate that social comparison standards which are presented outside of participants’ awareness influence self-evaluations. As is true for deliberate comparisons (e.g., Mussweiler & Strack, 2000), our participants assimilated evaluations of their characteristics and abilities towards the subliminally presented moderate standards. A potential standard may thus be used for social comparison, even if standard exposure is so fleeting that people remain unaware of it.

Would comparisons with such fleeting standards depend on the same standard characteristics that critically shape more deliberate comparison processes? Our previous research suggests that one such important characteristic is standard extremity (Mussweiler et al., in press). Whether deliberate comparisons with explicitly provided standards involve the comparison processes of similarity or dissimilarity testing (Mussweiler, 2003) and whether they consequently lead to assimilation or contrast critically depends on the extremity of the standard (Mussweiler et al., in press). Does this also hold for subliminal standards? Are self-evaluations assimilated towards moderate standards and contrasted away from extreme standards, as is the case for deliberate social comparisons? Study 2 was designed to examine this question concerning the direction of comparison consequences.

Study 2

To do so, participants were subliminally primed with a high versus low comparison standard that was either

¹ Note that z values do not add up to 0 because of uneven cell sizes.

moderate or extreme on athletic ability while evaluating themselves on this dimension.

Method

Participants

We recruited 55 students at the University of Würzburg as participants under the same conditions described in Study 1.

Materials and procedures

Procedures were similar to those applied in Study 1, with the exception of the self-evaluative dimension (athletic abilities) and the social comparison standards. This time, participants were asked to reflect upon their athletic abilities for about 1 min. Furthermore, while doing so, we subliminally presented participants with one of four standards of athletic ability using the same procedure as in Study 1: a moderately low standard (the former US president Bill Clinton), a moderately high standard (the former race car driver Nicki Lauda), an extremely low standard (Pope John Paul), or an extremely high standard (the former basketball professional Michael Jordan). All of these standards have been used in our previous research on self-evaluative consequences of deliberate comparisons (Mussweiler & Strack, 2000; Mussweiler et al., in press). Moreover, based on the results of a pretest ($N = 21$), the moderate standards were selected so that the mean self-rating ($M = 5.2$) was in between mean ratings for the moderately low ($M = 3.9$) and the moderately high standard ($M = 6.8$). Subsequent to the standard priming, participants evaluated their athletic abilities using absolute judgments. They indicated the maximum number of push-ups they can perform as well as the minimum time they need to run 100 m. Finally, they answered the same awareness check questions as before.

Results and discussion

One of the participants indicated that he had detected one of the prime words but was unable to report it. Because it is not entirely clear whether primes remained subliminal for this participant, he was excluded from further analyses.

We excluded those estimates from the analyses that were completely unrealistic. In particular, running time estimates that were below the world record (10 s), or above walking speed (60 s) as well as estimates of more than 100 push-ups were excluded.² We z -transformed, partly reverse scored (running time) and averaged the remaining responses into one athletic abilities score (Cronbach's $\alpha = .48$).

² Including these outliers did not change the obtained pattern of means.

We expected participants' self-evaluations to depend on the subliminally presented social comparison standards. More specifically, our findings for deliberate social comparisons with explicitly provided standards suggest that self-evaluations may be assimilated towards moderate standards and contrasted away from extreme standards. Inspection of Fig. 1 reveals that the self-evaluative consequences of social comparison with subliminal standards did indeed critically depend on standard extremity. As was true in Study 1, participants assimilated self-evaluations toward moderate comparison standards and evaluated themselves to be more athletic if they had been exposed to the moderately high standard ($M = .31$) rather than the moderately low standard ($M = -.26$), $t(50) = 1.7$, $p < .09$ (two-tailed). However, participants contrasted self-evaluations away from the extreme standards, and evaluated themselves to be less athletic if they had been exposed to the extremely high standard ($M = -.25$) rather than the extremely low standard ($M = .32$), $t(50) = 1.8$, $p < .08$ (two-tailed). This pattern was borne out in a significant interaction effect in an ANOVA using participants' athletic abilities scores as the dependent measure, $F(1, 50) = 6.1$, $p < .02$.

These findings indicate that how subliminal standards influence self-evaluations depends on their extremity. Subliminal exposure to moderate standards has assimilative self-evaluative consequences, whereas extreme standards yield contrast.

Taken together, the results of Studies 1 and 2 demonstrate that subliminal exposure to social comparison standards can influence self-evaluations. Social comparisons may thus even be engaged with a potential standard who was only fleetingly present—so fleetingly that participants remained unaware of it. Notably, one precondition may have to be fulfilled for such self-evaluative effects of social comparison standards to occur. In both studies, participants were in the process of reflecting upon their own qualities during standard exposure. Doing so may ensure that the comparison standards are related to the self immediately upon their

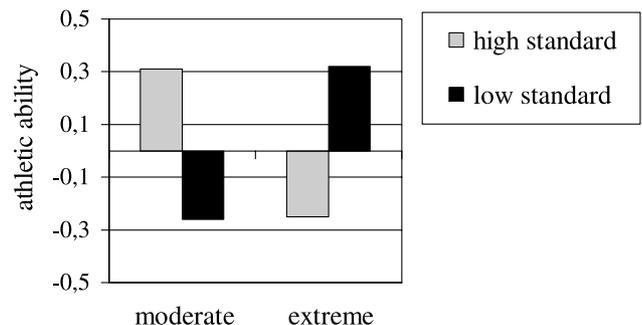


Fig. 1. Self-evaluations of athletic ability (z-transformed) of participants who were subliminally exposed to a moderate versus extreme, high versus low social comparison standard (Study 2).

presentation. It has been suggested that coaccessibility of two concepts is an important precondition of comparison activity (Kruglanski & Mayseless, 1990). Reflecting upon the self while being exposed to a social comparison standard ensures that both are accessible at the same time and consequently increases the likelihood of comparison. In this respect, self-reflection about one's standing on the critical dimension may well be a necessary precondition for the obtained effects to occur. Study 3 was designed to examine whether a subliminally presented social comparison standard only influences self-evaluation, if participants are self-reflecting during standard exposure.

Study 3

To do so, we manipulated whether participants were reflecting about their own standing on the judgmental dimension or about the nature of this dimension when exposed to the comparison standard. More specifically, participants were either asked to think about their own aggressiveness or about the concept of aggressiveness as such. The above reasoning suggests that self-reflection during standard exposure may be a necessary precondition for the effects of subliminal standards. If this is the case, then self-evaluations should only be influenced by the subliminally presented standards, if participants are reflecting on their own aggressiveness during standard exposure. Self-evaluations should remain uninfluenced, however, if participants are reflecting on the dimension of aggressiveness during standard exposure.

Method

Participants

We recruited 47 students at the University of Würzburg as participants. They were contacted in the University cafeteria, led to a separate room and offered a chocolate bar as a compensation.

Materials and procedure

Upon arrival in the lab, participants were led to individual booths and seated in front of computer monitors. Instructions informed them that they were to engage in a series of evaluation tasks concerning the dimension of aggressiveness. More specifically, they would be asked a series of questions that pertained to the general concept of aggressiveness and some related topics. About half of the participants were then asked to reflect upon their own aggressiveness and consider how aggressive they are for about 1 min. The other half were asked to reflect upon the general concept of aggressiveness and consider which aspects this concept includes. As in the previous studies, we instructed

participants to focus on a fixation string that was presented in the center of the screen during the reflection. To further ensure the subliminal nature of our primes, we somewhat modified our procedures. The fixation string was replaced by the name of the social comparison standard that was presented for 33 ms and immediately masked. A total of 6 different fixation strings (e.g., &\$\$?#B#\$\$%@&% , #?B\$\$&?%B?&\$) was presented before and after the prime. The number and presentation times of these fixation strings were varied. Specifically, between 2 and 4 different masks were presented for 500, 800 or 1000 ms before and after the prime. Fixation strings were thus presented for between 1800 and 3300 ms before and after the prime. We have used similar masking procedures in our research (Mussweiler & Englich, 2004) and have repeatedly found that it successfully ensures the subliminal nature of the primes. This sequence was repeated 10 times, so that participants were subliminally exposed to the name of a potential comparison standard for 10 times. About half of the participants were exposed to the name of a moderately high standard of aggressiveness (the former actor Arnold Schwarzenegger), the other half with a moderately low standard (the German pop-singer Nena). Both standards were pretested in the separate study described before ($N = 21$) in which their aggressiveness was rated to be similar to that of the standards used in Study 1 ($M = 5.7$ for Schwarzenegger and $M = 2.3$ for Nena).

After the priming task, participants evaluated their own aggressiveness using the same absolute judgments as in Study 1. To keep up the cover story about our ostensible interest in the general concept of aggressiveness, participants then listed three core aspects of aggressiveness. Finally, we again used a funneled debriefing to test for participants' awareness of the primes.

Results and discussion

Analyses of the awareness check questions revealed that none of the participants were able to report the standard names that were presented. We z -transformed answers to the self-evaluative questions and averaged them into one aggressiveness score (*Cronbach's* $\alpha = .67$).

We expected participants' self-evaluations to depend on the subliminally presented social comparison standards as well as the type of reflection they engaged in during exposure to these standards. More specifically, the results of the previous studies indicate that self-evaluations should be assimilated to the moderate comparison standards used in Study 3. This assimilation effect, however, may be primarily apparent for participants who reflected about their aggressiveness. Inspection of Fig. 2 reveals that the self-evaluative consequences of subliminal exposure to social comparison

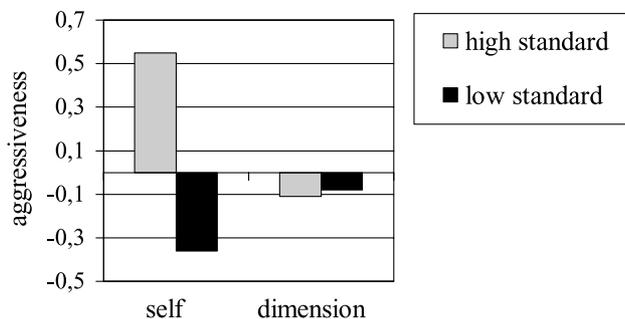


Fig. 2. Self-evaluations of aggressiveness (z -transformed) of participants who were subliminally exposed to a moderate high versus low social comparison standard while reflecting on the self versus the critical dimension (Study 3).

standards critically depended on the type of reflection process. Consistent with the results of Studies 1 and 2, participants who reflected upon their own aggressiveness evaluated themselves to be more aggressive after exposure to a moderately high standard ($M = .54$) than after exposure to a moderately low standard ($M = -.36$), $t(43) = 3.1$, $p < .01$ (two-tailed). Participants who reflected upon the general concept of aggressiveness, however, remained uninfluenced by the subliminal standards ($M = -.11$ versus $M = -.07$), $t(43) < 1$. This pattern was borne out in a significant interaction effect in an ANOVA using participants' aggressiveness scores as the dependent measure, $F(1, 43) = 4.97$, $p < .03$.

These findings demonstrate that self-evaluations of aggressiveness were only influenced by subliminally presented standards, if participants were reflecting upon their own aggressiveness during standard exposure. When reflecting about the concept of aggressiveness per se, self-evaluations remained uninfluenced by the presented standards. This suggests that self-reflection during standard exposure may indeed be a necessary precondition for the self-evaluative effects of subliminal standards to occur.

General discussion

Taken together, the present findings indicate that—under specific conditions—subliminal exposure to social comparison standards influences self-evaluations. Standards who—from the judges' perspective—are not even there, sometimes still appear to be used for comparison. These findings demonstrate that social comparisons can be engaged even with comparison standards to whom people have been exposed rather fleetingly. Self-evaluative comparisons are thus not only engaged with standards who have been explicitly provided or deliberately selected. Rather, they can be spontaneously carried out even under conditions of minimal exposure. Notably, Study 2 demonstrates that subliminal standards can

even be used for comparison if they are maximally different from the self. The extreme standards Michael Jordan and Pope John Paul do not only differ from our participants on the critical dimension itself, but also on salient comparison-related attributes (e.g., profession, age, and ethnicity). Despite this striking dissimilarity, participants compared themselves with these extreme standards, as is evident in the standards' influence on self-evaluations. The fact that participants compared with potential standards even if they were unaware of them, and even if they were unlikely to yield valuable information emphasizes that spontaneous social comparisons are truly ubiquitous.

At the same time, such spontaneous comparisons are highly flexible in that they do not invariably take the same form and yield the same consequence. Depending on the nature of the comparison standard, different comparison mechanisms with diverging consequences are engaged. The assimilative versus contrastive consequences of comparisons with moderate versus extreme standards that we have obtained in the present research, converge with similar findings on the consequences of priming in social judgment (Herr, 1986) and the consequences of deliberate comparisons with supraliminal standards (Mussweiler et al., in press). This latter research further demonstrates that these diverging self-evaluative consequences are produced by the two alternative comparison mechanisms of similarity and dissimilarity testing (Mussweiler, 2003). In comparing themselves to a moderate standard people selectively seek and activate knowledge indicating that they are similar to the standard. In comparing themselves to an extreme standard, however, people selectively seek information indicating that they are different from the standard. The fact that spontaneous comparisons with subliminal standards depend on standard extremity in much the same way, suggests that they involve the same comparison processes. The alternative comparison mechanisms of similarity and dissimilarity testing thus appear to be operating in deliberate and spontaneous comparisons with standards that are explicitly provided, deliberately selected, or subliminally presented.

The present research builds on previous work on the spontaneity of social comparisons in a number of ways. Gilbert et al. (1995) demonstrated that participants spontaneously engage in social comparisons with irrelevant others. Our research extends these seminal findings in at least three important ways. In Gilbert et al. (1995) participants evaluated themselves on novel dimensions (e.g., ability to detect schizophrenia) for which they were unlikely to have alternative standards available. The present findings demonstrate that comparisons with irrelevant standards are even spontaneously carried out for self-evaluations on basic personality dimensions (aggressiveness) and core abilities (athletic performance) for which a multitude of alternative standards exist.

More importantly, the present findings demonstrate that very brief exposure can be sufficient for a standard to be used for comparison. In Gilbert et al. (1995) participants were extensively exposed to comparison information while observing the potential standard perform the same task that they were about to perform. In the present studies, exposure to the standard was so brief that participants remained unaware of it. Still—under specific conditions—such fleeting exposure to standard information was sufficient to influence subsequent self-evaluations. Finally, the present research identifies a boundary condition for spontaneous social comparisons. In Study 3, subliminal exposure only influenced self-evaluations, if participants reflected upon their own qualities during standard presentation. Fleeting exposure to a potential standard thus only appears to influence self-evaluations if this standard can immediately be related to the self. If this is not the case, because participants work on a judgment task that does not directly involve self-reflection, then subliminal standards are not used for social comparison. This finding is consistent with the notion that coaccessibility of two concepts is an important precondition of comparison activity (Kruglanski & Mayseless, 1990). At the same time, previous research has repeatedly demonstrated that primes may influence target evaluations, even if judges do not reflect on the judgmental target during standard exposure (e.g., Herr, 1986). Clearly, identifying the exact psychological mechanisms that underlie this boundary condition is beyond the scope of the present studies and bears further examination by future research.

One core implication of this research is that people may be less selective in their social comparison activities than has traditionally been assumed (Festinger, 1954). In our studies, fleeting exposure to a potential standard was sufficient to trigger social comparison. Such minimal exposure, however, is a constant byproduct of many daily routines. No matter whether we are flipping through a magazine, overhearing a conversation, or watching television, we are constantly exposed to social comparison information. The present findings suggest that oftentimes, we may indeed relate this information to ourselves. At the same time, these findings point to one precondition that has to be fulfilled for social comparison to be carried out. In the present studies, subliminal standards only influenced self-evaluations if participants were reflecting upon themselves when they were presented with the standards. Fleeting presented social standards may thus only be used for comparison, if people are in the process of self-reflection. Notably, this often seems to be the case. In fact, people appear to spend much of their time reflecting upon and evaluating themselves. In one study (Csikszentmihalyi & Figurski, 1982), for example, about 8% of all thoughts participants had in the course of the day pertained to the self. Self-evaluation thus appears to be one of our most fre-

quent and prevalent mental activities. This pervasiveness of self-evaluative thoughts together with the endless stream of information about potential standards may continuously engage people in social comparison activities. Spontaneous comparisons with others thus appear to be a truly ubiquitous process.

In light of this ubiquity social comparisons have to be highly efficient processes. If people do indeed constantly compare with others, then—to prevent cognitive overload—they can only use little processing capacities for such comparisons. For a process that is engaged as frequently as social comparison, proceduralization, and automatization (Bargh, 1997; Dijksterhuis & Bargh, 2001; Smith, 1994) are important capacity saving devices (Mussweiler & Rüter, 2003). As is true for other psychological processes that are repeatedly engaged, social comparisons are likely to become proceduralized so that they can be carried out in relatively automatic ways. This may enable people to constantly compare with others, without draining too much of their scarce cognitive resources.

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