European Journal of Social Psychology, Vol. 21, 37–48 (1991)

Accentuation effects and illusory change in exemplar-based category learning

JOACHIM KRUEGER
Max Planck Institute for Human Development and Education, Berlin, Germany

Abstract

Examined the hypothesis that information enhancing category differences receives greater weight in estimates of category means than information that reduces such differences. In the first experiment, subjects estimated the cumulative means of test scores of two groups of students. The experimental manipulation involved a gradual shift of the true mean of one group either towards or away from the true mean of the other group. As predicted, changes of estimates were larger when the two means became more dissimilar than when they became more similar. The second experiment involved otherwise identical procedures, but the variance in one category was increased while the mean remained stable. Subjects perceived an illusory change of the mean away from the comparison category. It is suggested that accentuation effects of this kind may limit the reduction of social stereotypes.

INTRODUCTION

Social stereotypes often involve ethnocentric beliefs and exaggerated perceptions of group differences. Ingroups are typically evaluated more positively than outgroups and perceptions focus on group differences rather than similarities. Clarke and Campbell (1955), for example, reported that white subjects enhanced intergroup contrasts by underestimating the average academic ability of blacks. Freud believed that even small between-group differences can activate 'sediments of feelings of aversion and hostility' (Freud, 1921/1959, p. 33), and research in the minimal-group paradigm even suggests that group differences are perceived when no differences exist other than the grouping itself (e.g. Howard and Rothbart, 1980).

This research was conducted while the author was a PhD student at the University of Oregon. Financial support was available from National Institute of Health Grant MH 40662–02 to Myron Rothbart.

I am enormously indebted to Myron Rothbart and N. Sriram for their generous assistance and encouragement and to Klaus Fiedler, Lewis Goldberg, Ulman Lindenberger, Anna Maciel, Gabriele Oettingen, Anne Sutter, and four anonymous reviewers for their thoughtful comments on earlier versions of this article. Address correspondence to Joachim Krueger, Max Planck Institute for Human Development and Education, Lentzeallee 94, 1000 Berlin 33, FRG.

0046–2772/91/010037–12$06.00

Received 8 January 1990
Accepted 14 September 1990

Two sources of information may contribute to perceived between-group differences. People may hold abstract stereotyped beliefs, or they may acquire knowledge about exemplars through direct experience (Park and Hastie, 1987). Experimental evidence suggests that exemplar-based learning all by itself can produce inflated beliefs about between-group differences. Tajfel (1969) hypothesized that simplified group stereotypes may arise from processes of perceptual assimilation and accentuation. He suggested that when category information regarding group membership is superimposed on information about continuously graded individual characteristics, within-category differences are minimized and between-category differences are accentuated. Tajfel and Wilkes (1963) tested this hypothesis in an experiment on physical judgement. Subjects estimated the lengths of eight lines which were associated with two mutually exclusive categories. In one condition, the four shorter lines were labelled A and the four longer lines were labelled B. As predicted, subjects accentuated between-category differences by overestimating the differences between the longest A line and the shortest B line. When labels regarding category membership were assigned randomly or when no labels were provided, the effect disappeared. There was no evidence for within-category assimilation.

In the Tajfel and Wilkes (1963) study, actual intercategory differences were large. All lines of one category were longer than any of the lines of the other category. That is, there was a perfect biserial correlation between the category and the continuous variable. Subsequent research found accentuation effects, albeit with a smaller effect size, even when categories were imperfectly correlated with the graded continua (Lilli and Lehner, 1971). In other words, there was a tendency to overestimate the correlation between the two variables.

The present study investigates estimates of category means rather than perceptions of individual exemplars. Are between-group differences accentuated when subjects judge the central tendencies of categories? Research on intuitive statistics shows that means can be estimated with ease and a fair degree of accuracy when subjects are presented with numbers belonging to one category (Peterson and Beach, 1967). Cognition of social (Hastie and Park, 1986) and object categories (Barsalou, 1985) involve mean estimates of a variety of categories. Gender stereotypes, for example, reflect beliefs that the average man is more aggressive than the average woman (Krueger and Rothbart, 1988). Because stereotypes can be reflected in perceived mean differences between groups, the intuitive abstraction of group means is the methodological focus of the present study.

In previous research, we tested accentuation effects in the learning of categories consisting of numbers that had no social relevance (Krueger, Rothbart and Sriram, 1989). Subjects estimated the means of two categories. During the first half of the procedures the true means remained stable and estimated means did not accentuate between-category differences. During the second half, true means were manipulated experimentally so that the mean in one category either became more similar to the comparison category or more dissimilar to it. At this time, between-category differences were accentuated. Changes in estimates were greater when the true difference between the means became larger than when it became smaller. This effect of accentuated change could not be attributed to distorted perceptions or representations of individual stimuli (Tajfel and Wilkes, 1963; Upmeyer, 1981) because the individual numbers were recognized and not estimated. We suggested that 'memory processes might be involved in the simplification of perceived category structure' (Krueger

et al., 1989, p. 874). That is, category exemplars that sharpen inter-category distinctions may be more salient and memorable than exemplars that blur such distinctions.

The present study has two goals. The first is to replicate the accentuation of change effect with person categories varying in favourability. Therefore, numbers are presented to subjects as scores on a test of verbal intelligence, thus reflecting a socially desirable attribute. In line with previous research it is hypothesized that changes of mean estimates will be greater when the true mean of one category moves away from the comparison category than when it moves toward it.

The second goal is to investigate how perceptions of group means change over time. In category learning, beliefs may be either maintained or revised as a function of accumulating relevant experience. In regard to stereotypes, Rothbart (1981) suggested that change may either involve processes of gradual book-keeping or sudden conversion. Because the present task involves unambiguous numbers, it seems plausible that changes in mean estimates closely mirror changes in true means and thus correspond to the book-keeping model.

EXPERIMENT 1

Experiment 1 consisted of two phases. In phase 1, subjects were presented with two intermixed sets of 24 three-digit numbers. Numbers purportedly represented high school students' scores on a test of non-verbal intelligence. Greater numbers represented better scores. After each presentation, subjects typed the number into a computer, along with a letter identifying the group to which the score belonged. Subjects estimated the cumulative mean for each of the two groups of test scores six times, after each block of eight numbers.

During phase 2, subjects saw 48 additional scores, 24 in each group. In the *focal* group, the additional scores either increased or decreased the cumulative mean, whereas in the *contextual* group the cumulative mean remained constant. For half the subjects, the contextual mean was larger than the focal mean and for half it was smaller. As in phase 1, subjects typed in each number and its group label, and estimated the two cumulative means six times, after each block of eight numbers.

Method

Subjects and procedure

Fifty-three students of the University of Oregon participated in 50-minute sessions in groups of four in exchange for credit in an introductory psychology course. They were informed that the study was concerned with impression formation about social groups, and that averaging is involved in everyday processes of abstracting general group information from individual members. They were also told that in order to study intuitive averaging, information about group members would be presented in a numerical format. Subjects were assured that the experiment was not a test of their mathematical ability.

Personal computers were programmed to present 96 three-digit numbers for 2 seconds each. The numbers were presented as the outcome of a study on non-verbal intelligence with two groups of children, high- and low-achieving high school

students. Greater numbers reflected better test scores. Before each number presentation, a letter was presented on the screen for 500 ms to identify the number with one of the two groups. In addition, group membership of each score was conveyed by different type fonts.

After each presentation, subjects typed in the letter to confirm the group membership of the presented score, and they entered the number itself. The total of 96 numbers was broken down into 12 blocks of eight numbers each. Within each block there were four numbers of each group, presented in random order. After each block, subjects were asked to estimate the cumulative mean test score separately for each group of students. To arrive at this cumulative mean, they were asked to consider all the scores they had seen since the beginning of the experiment.

Design and stimulus materials

The first half of the experiment (phase 1) was the mean-learning phase. Numbers ranged from 129 to 182. By the end of block 6, the 48 presented numbers made up two equally large, unimodal, and symmetrical distributions with standard deviations of 4.90. The two distributions did not overlap but bordered one another, and the means were 18 points apart. The three blocks of phase 1 were considered practice trials and were not analysed.

The second half of the experiment (phase 2, blocks 7 to 12) was the mean-change phase. For the contextual group, the same numbers as in phase 1 were presented in a newly randomized order. Thus, the cumulative mean did not change across the two phases. For the focal group, however, 18 of the additional 24 numbers were outside the range established in phase 1. On the average, these deviating numbers were either 18 points greater or 18 points smaller than the mean of the focal group in phase 1. By the end of block 12, the cumulative mean had changed by six points.

In all conditions, the mean of the focal group was 155.5 after phase 1. For half the subjects the contextual group was composed of larger numbers ($M = 173.5$), and for the other half of smaller numbers ($M = 137.5$). The direction of change in the focal group was varied so that at the end of phase 2, the mean had either become greater ($M = 161.5$) or smaller ($M = 149.5$). The resulting design was a 2 (increasing versus decreasing true mean in the focal group) by 2 (large versus small stable mean in the contextual category) by 9 (blocks 4 to 12), with repeated measures on the last factor.

Depending on the direction of change of the true focal mean and the location of the contextual mean, actual intercategory differences were either reduced or enhanced. They were *reduced* when the contextual mean was large and the focal mean increased, or when the contextual mean was small and the focal mean decreased. Conversely, they were *enhanced* when the contextual mean was large and the focal mean decreased, or when the contextual mean was small and the focal mean increased. Table 1 shows the number stimuli for each category, focal and contextual, presented during the two phases of the experiment.

Dependent variables

First, estimates of the cumulative means in the focal category were collected at the end of each of the 12 blocks. Second, individual difference scores of changes of

Table 1. Experiment 1: Number stimuli presented in the focal and contextual categories in phase 1 and in phase 2

Phase 1																	
Focal category		149			152			155	156			159			162		
	147	149	150	151	152	153	154	155	156	157	158	159	160	161	162	164	
Small contextual category		131			134			137	138			141			144		
	129	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	
Large contextual category		167			170			173	174			177			180		
	165	167	168	169	170	171	172	173	174	175	176	177	178	179	180	182	
Phase 2																	
Focal category/ decreasing							137	138									
	129	131	132	133	134	136	137	138	139	141	142	143	144	146	147	–	
	–	150	152	154	157	159	161	164									
Focal category/ increasing															173		
	147	150	152	154	157	159	161	164	165	167	168	169	170	172	173	–	
	–	174	175	177	178	179	180	182									
Small contextual category		131			134			137	138			141			144		
	129	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	
Large contextual category		167			170			173	174			177			180		
	165	167	168	169	170	171	172	173	174	175	176	177	178	179	180	182	

mean estimates were computed by subtracting the last estimate in phase 1 (block 6) from each of six estimates in phase 2.

Results

Estimated means

Table 2 shows the estimated means and the true means in the focal group in blocks 4 to 12 for the four conditions. At the end of phase 1, the averaged estimates of the means were close to the true mean, and were not accentuated away from the contextual category. Instead, estimates in the focal group were smaller when the contextual group was low ($M = 154.78$) than when the contextual group was high ($M = 156.61$), $t(52) = 2.80$, $p < 0.05$. Thus focal estimates were assimilated to the contextual group, rather than accentuated away from it.

To test the effects of new numbers in phase 2 on mean estimates, a three-way analysis of variance (ANOVA) was performed for the focal category, with direction of change (increase versus decrease) and the contextual category (large versus small) as between-subjects variables and the nine blocks as repeated measures. First, estimates increased when higher test scores were added ($M = 164.45$), and they decreased when lower test scores were added ($M = 145.62$), $F(1, 52) = 182.00$, $p < 0.001$.

Table 2. Experiment 1: Estimated and true means in the focal category

	Change in the focal category					
	Decreasing			Increasing		
Contextual category	Small (reduct.)	Large (enhance.)	True *M*	Small (enhance.)	Large (reduct.)	True *M*
Blocks (phase 1)						
4	154.83	156.23	155.50	154.08	157.00	155.50
5	153.83	156.69	155.50	155.00	157.18	155.50
6	154.56	156.77	155.50	155.00	156.45	155.50
Blocks (phase 2)						
7	150.56	151.23	153.79	160.92	162.82	157.21
8	148.83	150.38	152.50	163.17	163.55	158.50
9	148.17	148.31	151.50	163.00	163.73	159.50
10	146.50	145.85	150.70	163.58	164.91	160.30
11	145.89	144.38	150.05	165.67	165.45	160.95
12	146.39	144.85	149.50	165.08	163.82	161.50

Second, and more important, estimates changed across blocks to a larger extent when true intercategory differences were enhanced than when they were reduced. Accentuation of change in the expected direction was supported by a three-way interaction between direction of change, location of contextual category, and blocks, $F(8, 416) = 2.03$, $p < 0.05$. When the true means decreased, changes of estimates across blocks were more extreme when the mean of the contextual category was large than when it was small. When the true means increased, the pattern was reversed. No other effects were significant.

To test whether estimated means in the contextual groups remained stable across phases, paired *t*-tests were performed comparing estimated contextual means in phase 1 and in phase 2. None of these tests was significant (all $ps > 0.10$), indicating that the category-accentuation effect in the focal group resulted in a magnification of perceived between-group differences in phase 2.

Difference score

The foregoing analysis revealed that the accentuation effect emerged no matter whether the true focal means became larger or smaller. When the true means decreased, estimates changed by 3.75 points *more* in the enhancement condition than in the reduction condition, and when the true means increased the respective difference was 2.71 points. This finding permitted the computation of a single set of difference scores combining the data of the two conditions of differing direction of change. For each subject, the difference score was assigned a positive sign when the direction of estimated change was concordant with the direction of actual change and a negative sign when the observed direction was opposite the expected direction. Hence, the conditions of direction-down/large context and direction-up/small context were collapsed into a single condition of enhancement of intergroup differences, and similarly, the conditions of direction-down/small context and direction-up/large context were collapsed into a single condition of reduction of intergroup differences.

Table 3 shows the mean difference scores for the conditions of enhancement and reduction as well as the mean true change. Data were analysed in a 2 (enhancement

versus reduction) by 6 (blocks) mixed analysis of variance. The effect of the repeated factor blocks indicated that mean estimates changed when new information was introduced, $F(5, 260) = 34.60$, $p < 0.01$. More importantly, this change was greater when intergroup differences were enhanced ($M = 8.92$) than when they were reduced ($M = 7.22$), $F(1, 52) = 4.32$, $p < 0.05$), and this effect was consistent across all six blocks. That is, there was no interaction between the two factors, $F < 1$.

Table 3. Experiment 1: Difference scores (blocks in phase 2 minus block 6) for the enhancement condition, the reduction condition, and true change

Blocks	Enhancement	Reduction	True change
7	5.73	5.19	1.71
8	7.28	6.42	3.00
9	8.23	6.84	4.00
10	9.75	8.26	4.80
11	11.53	8.84	5.45
12	11.00	7.77	6.00

Changes of estimated means in the enhancement and in the reduction condition were greater than the changes in the true means ($M = 4.16$, all $ps < 0.01$). When estimating the cumulative mean, subjects probably had better recall for the most recently presented numbers.

Finally, inspection of Table 3 suggests that patterns of change across blocks were more representative of the book-keeping model than the conversion model. At least on the level of aggregated group means there was no indication of discontinuous change. It should be noted, however, that group means may mask abrupt individual changes occurring on different blocks.

Discussion

Experiment 1 showed that during the exemplar-based learning of two sets of numbers, mean estimates reflected a category accentuation effect. The introduction of new information about group members was weighted more heavily when intergroup differences were enhanced than when they were reduced. The accentuation effect emerged despite the emphasis of the experimental procedures on judgemental accuracy, and although the non-ambiguous stimuli precluded perceptual distortions. As in our earlier research (Krueger *et al.*, 1989), however, between-category differences were not accentuated while the true means remained stable (phase 1). In phase 2, when the true means changed, results were indicative of gradual rather than abrupt shifts. The cognitive processes underlying these changes are thus more in line with the book-keeping model of belief change than with the conversion model (Rothbart, 1981).

In Experiment 1, true mean changes entailed an asymmetrical increase in the variance of the focal distribution. For half the subjects, the skewed tail of the distribution extended to the low range of test scores; for the other half, the tail extended to the high range of scores. Encountering new group information exclusively on one side of the distribution may be the exception rather than the rule in real-life situations

of intergroup contact. Rather, observers of groups may encounter information that enhances and information that reduces intercategory differences at the same time. Thus, increased familiarity with groups may lead to an increase in perceived variance (Linville, Fischer and Salovey, 1989). In principle, there could be increases in variance without any changes in the mean. Yet, intercategory differences may be accentuated if new information about differences to a comparison group receives greater weight in mean estimates than information about similarities. When the true mean of a group of numbers is held constant and a mere increase in category variance produces changes in estimated means, these changes would be illusory. Experiment 2 tested this hypothesis.

EXPERIMENT 2

The mean of the focal category was held constant throughout both phases of the experiment, whereas the variance increased in phase 2. Subjects again received numbers enhancing and reducing intercategory differences. It was hypothesized that information that enhances intercategory distinctions carried greater judgemental weight than information that reduced such distinctions. Therefore, estimated means should be displaced away from the contextual mean in phase 2. For phase 1, the results of Experiment 1 were expected to be replicated and the focal means were predicted not to be displaced away from the contextual means.

Method

Subjects and procedure

Ninety-one students at the University of Oregon participated in the experiment in partial fulfillment of course requirements. With two exceptions, Experiment 2 was identical to Experiment 1. First, numbers were not introduced as test scores. Subjects were simply told they were participating in a study in statistical estimation. Second, the means in both the focal and the contextual categories remained stable throughout the experiment. The numbers presented in phase 1 were identical to the numbers presented in phase 1 of Experiment 1. In phase 2, the range of numbers in the focal category increased from 18 (147–165) to 54 points (129–182), and the variance increased from 4.9 in phase 1 to 17.63 in phase 2. The variance of the complete set of focal numbers (phase 1 and phase 2) was 12.63. All presented numbers are displayed in Table 4.

Results and discussion

As in Experiment 1, the first three estimates in phase 1 were considered unreliable practice trials and discarded from analyses. The nine estimates and the six difference scores (*M*s(phase 2) minus block 6 (phase 1) are shown in Table 5.

Estimated focal means in phase 1 did not show a category-accentuation effect. When the contextual category consisted of large numbers, the last estimates in phase 1 (block 6) ($M = 155.65$) was close to the true mean ($M = 1155.50$). When the contextual category consisted of smaller numbers, however, focal estimates were smaller

Table 4. Experiment 2: Number stimuli presented in the focal and contextual categories in phase 1 and in phase 2

Phase 1																	
Focal								155	156								
category		149			152			155	156			159			162		
	147	149	150	151	152	153	154	155	156	157	158	159	160	161	162	164	
Small								137	138								
contextual		131			134			137	138			141			144		
category	129	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	
Large								173	174								
contextual		167			170			173	174			177			180		
category	165	167	168	169	170	171	172	173	174	175	176	177	178	179	180	182	
Phase 2																	
Focal	129	132	134	136	137	138	139	141	143	146	150	154	157	161	165	–	
category	–	168	170	172	173	174	175	177	179	182							
Small								137	138								
contextual		131			134			137	138			141			144		
category	129	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	
Large								173	174								
contextual		167			170			173	174			177			180		
category	165	167	168	169	170	171	172	173	174	175	176	177	178	179	180	182	

Table 5. Experiment 2: Averaged estimates of the means in the focal category and average differences scores (blocks in phase 2 minus block 6)

	Large		Small	
Contextual category	Estimates	Difference score	Estimates	Difference score
Blocks (phase 1)				
4	155.89	—	152.14	—
5	155.00	—	152.61	—
6	155.65	—	152.73	—
Blocks (phase 2)				
7	153.74	−1.91	153.02	0.29
8	152.93	−2.72	153.16	0.43
9	155.04	−0.61	154.75	2.02
10	154.43	−1.22	155.86	3.13
11	154.22	−1.74	156.52	3.79
12	154.91	−0.74	155.20	2.47

($M = 152.73$), $t(90) = 6.24$, $p < 0.01$. As in Experiment 1, focal estimates in phase 1 may have been assimilated to the contextual category, and it is unclear why this effect occurred only in the condition of small contextual numbers.

Before testing accentuation effects in the focal means in phase 2, estimates of the contextual means were analysed. Estimates in phase 1 were averaged and compared to the averaged estimates in phase 2. Paired t-tests revealed no differences between phases, $ps > 0.10$.

Focal estimates, however, showed the predicted accentuation effect despite the stability of the true means across phases. A two-way analysis of variance (ANOVA)

with the contextual category (large versus small) as a between-subjects variable and blocks (six levels) as the repeated-measures variable yielded no significant main effects, but a significant interaction, $F(5, 450) = 5.03$, $p < 0.01$. When the contextual category consisted of large numbers, all six focal estimates in phase 2 were smaller than the last estimate in phase 1. On the average, focal means decreased by 1.44 points (M(phase 2) = 154.21), $t(40) = 2.12$, $p < 0.05$. Conversely, when the context consisted of small numbers, all focal estimates were larger than the last estimate in phase 1. The average increment was 2.02 points (M(phase 2) = 154.75), $t(39) = 5.32$, $p < 0.01$. Though the size of the accentuation effects was small, the consistency with which it emerged across the six blocks of phase 2 underscores its significance.

The results of Experiment 2 show that (a) in the initial stage of mean-learning, estimates were not accentuated away from each other, and that (b) a mere increase in category variance was sufficient to produce an accentuation of perceived inter-category distinctions. These findings represent an increase in ecological validity over Experiment 1 because a symmetrical increase in group variance is more likely in real-life settings than a one-tailed increase. Finally, the numbers were not graded on an evaluative scale. Whereas in Experiment 1 larger numbers indicated superior performance on a test, larger numbers in Experiment 2 were simply greater but not better than smaller numbers.

GENERAL DISCUSSION

In the present study, changes in estimated category means were greater when inter-category differences were enhanced than when they were reduced. Furthermore, a mere increase in variance in one category without any true mean change was sufficient to produce an illusory change of the estimated means away from a contextual category. This accentuation of category change appeared with unambiguous stimuli under conditions of minimal personal involvement of the subjects. Overall, intuitive mean estimates followed a book-keeping model of gradual adjustments rather than a conversion model.

Why were mean estimates in the focal category displaced away from the contextual category in phase 2 but not on phase 1? As suggested earlier, difference-enhancing stimuli may have been recalled with greater ease than difference-reducing stimuli. In phase 2, numbers that enhanced intergroup differences lay outside the range that subjects had come to expect in phase 1 and thus were more salient than numbers that reduced intergroup differences. Research on stimulus salience suggests that distinctive stimuli attract more attention and are more available in memory than indistinctive stimuli (Taylor and Fiske, 1978; Tversky and Kahneman, 1973; von Restorff, 1933). Numbers in the focal category were the more salient the further away they were located from the contextual category. Superior recall for the outlying numbers would result in the observed accentuation effect.

The results of an earlier study in this paradigm indicated that differences in recall are indeed related to the accentuation effect. Krueger and Rothbart (1990, experiment 3) presented subjects with two sets of trait adjectives varying in favourability. In the second phase of the experiment, the variance of favourability was increased in one category and subjects estimated the mean favourability of each category. At the end of the experiment, subjects were asked to recall as many traits as they

could in each category. Results showed that recall increased with the difference between the favourability of the trait and the favourability of the comparison category.

An alternative explanation of the accentuation of change focuses on the region of intercategory overlap. A classical tenet of accentuation theory holds that stimuli falling into this region are assimilated toward their own category and accentuated away from the other category. As noted earlier, it is unlikely that perceptual biases distorted individual numbers toward the category's central tendency, but overlapping numbers may have been erroneously encoded or retrieved as distinct or non-overlapping with respect to the comparison category. This explanation construes accentuation of change as a sharpening of category boundaries rather than as enhanced availability of extreme stimuli.

More research is needed to determine whether accentuation effects are primarily due to processes involving extreme stimuli or to processes involving overlapping stimuli. For example, the design of Experiment 1 could be modified to allow the focal mean to change away or toward the contextual category without creating intercategory overlap. If perceived changes continue to be larger when intercategory differences are enhanced than when they are reduced, the accentuation can be attributed to the impact of extreme stimuli rather than the decreased availability of overlapping stimuli.

This article started with the notion that perceptions of group differences, when combined with ethnocentric attitudes, may be a source of social conflict. Although the present research did not involve the classification of subjects into groups, the findings suggest a note of caution in regard to the contact hypothesis of stereotype change. The contact hypothesis, in its simple form, states that negative social stereotypes improve when positive information about individual group members becomes available (Amir, 1976; Stephan, 1987). Inasmuch as social stereotypes involve distinctions between valued ingroups and disparaged outgroups (McCauley and Stitt, 1978; Tajfel and Turner, 1985), the polarization of stereotypes through the accentuation of change can limit the reduction of negative outgroup stereotypes. Positive information associated with outgroup members may be less salient and memorable than negative information because it blurs perceived between-group differences.

Nevertheless, the relative success of the book-keeping model to predict changes of mean estimates over time suggests that outgroup stereotypes could change in the desired direction when the quantity of positive information considerably outweighs negative information.

REFERENCES

Amir, Y. (1976). 'The role of intergroup contact in change of prejudice and ethnic relations'. In: Katz, L. (Ed.) *Toward the Elimination of Racism*. Pergamon Press, New York, pp. 245–308.

Barsalou, L. W. (1985). 'Ideals, central tendency, and frequency of instantiation as determinants of graded structure in categories', *Journal of Experimental Psychology: Learning, Memory, and Cognition*, **11:** 629–654.

Clarke, R. B. and Campbell, D. T. (1955). 'A demonstration of bias in estimates of Negro ability', *Journal of Abnormal and Social Psychology*, **51:** 585–588.

Freud, S. (1959, originally published in 1921). *Group Psychology and Ego Analysis*, W. W. Norton & Co., New York.

Hastie, R. and Park, B. (1986). 'The relationship between memory and judgment depends on whether the judgment task is memory-based or on-line', *Psychological Preview*, **93:** 258–268.

Howard, J. and Rothbart, M. (1980). 'Social categorization and memory for in-group and out-group behavior', *Journal of Personality and Social Psychology*, **38:** 301–310.

Krueger, J. and Rothbart, M. (1988). 'Use of categorical and individuating changes information in making inferences about personality', *Journal of Personality and Social Psychology*, **55:** 187–195.

Krueger, J. and Rothbart, M. (1990). 'Contrast and accentuation effects in category learning', *Journal of Personality and Social Psychology*, **59:** 651–663.

Krueger, J., Rothbart, M. and Sriram, N. (1989). 'Category learning and change: Differences in sensitivity to information that enhances or reduces intercategory distinctions', *Journal of Personality and Social Psychology*, **56:** 866–875.

Lilli, W. and Lehner, F. (1971). 'Stereotype Wahrnehmung: Eine Weiterentwicklung der Theorie Tajfels', *Zeitschrift für Sozial psychologie*, **2:** 285–294.

Linville, P. W., Fischer, G. W. and Salovey, P. (1989). 'Perceived distributions of the characteristics of in-group and out-group members: Empirical evidence and a computer simulation', *Journal of Personality and Social Psychology*, **57:** 165–188.

McCauley, C. and Stitt, C. L. (1978). 'An individual and quantitative measure of stereotypes', *Journal of Personality and Social Psychology*, **36:** 929–940.

Park, B. and Hastie, R. (1987). 'Perception of variability in category development: Instance-versus abstraction-based stereotypes', *Journal of Personality and Social Psychology*, **53:** 621–635.

Peterson, C. R. and Beach, L. R. (1967). 'Man as an intuitive statistician', *Psychological Bulletin*, **68:** 29–46.

Rothbart, M. (1981). 'Memory processes and social beliefs'. In: Hamilton, D. L. (Ed.) *Cognitive Processes in Stereotyping and Intergroup Behavior*, Erlbaum, New Jersey, pp. 145–181.

Stephan, W. G. (1987). 'The contact hypothesis in intergroup relations'. In: Hendrick, C. (Ed.) *Group Processes and Intergroup Relations: Review of Personality and Social Psychology*, Sagee, Beverly Hills.

Tajfel, H. (1969). 'Cognitive aspects of prejudice', *Journal of Social Issues*, **25:** 79–98.

Tajfel, H. and Turner, J. (1985). 'The social identity theory of intergroup behavior'. In: Worchel, S. and Austin, W. G. (Eds.) *Psychology of Intergroup Relations*, Nelson-Hall, Chicago, pp. 7–24.

Tajfel, H. and Wilkes, A.L. (1963). 'Classification and quantitative judgement', *British Journal of Social Psychology*, **54:** 101–114.

Taylor, S. E. and Fiske, S. T. (1978). 'Salience, attention and attribution: Top of the head phenomena'. In: Berkowitz, L. (Ed.) *Advances in Experimental Social Psychology*, Vol. 11, Academic Press, New York.

Tversky, A. and Kahneman, D. (1973). 'Availability: A heuristic for judging frequency and probability', *Cognitive Psychology*, **5:** 207–232.

Upmeyer, A. (1981). 'Perceptual and judgmental processes in social contexts'. In: Berkowitz, L. (Ed.) *Advances in Experimental Social Psychology*, Vol. 15, Academic Press, New York.

von Restorff, H. (1933). 'Ueber die Wirkung von Bereichsbildungen im Spurenfeld'. In: Koehler, W. and von Restorff, H. (Eds) *Analyse von Vorgaengen im Spurenfeld: 1. Psychologische Forschung*, Vol. 18, pp. 299–342.